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Nova Scotian Institute of Science

HALIFAX, NOVA SCOTIA

VOL. 25 1958-1959 PART 1

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Editor: H. S. Heaps
Editorial Board: Dixie Pelluet, J. A. McCarter and J. R. Dingle

Printed for the Institute by Rolph-Clark-Stone-Maritimes, Limited
Date of Publication: March, 1961

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PROCEEDINGS
OF THE
Nova Scotian Institute of Science

VOL. 25 - PART 1

THE ORTHOPTERA OF NOVA SCOTIA

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Nova Scotia Agricultural College, Truro, Nova Scotia.

(Received for publication, July 1, 1959, and in revised form November 5, 1960)

I. INTRODUCTION

Several papers have included references to species of Orthoptera from Nova Scotia. Four of these were devoted entirely to Nova Scotian species. This report is an attempt to bring the knowledge of the Orthoptera of Nova Scotia up to date. Seven names are added to the previously confirmed number of twenty-four species.

The first information of significance was provided by F. Walker (1869; 1870; and 1872). Twelve species were listed but unfortunately some of these were mis-identifications and only eight species have been subsequently confirmed. The specimens to which Walker referred were probably collected around Halifax by Lt. R. S. Redman from 1820 to 1822.

Nothing further was published until Scudder (1892) (See Piers, 1918) recorded the occurrence of an additional species from Nova Scotia. This was later said to be a mistake by Piers (1918) and the species, *Pardalophora apiculata* (Harris), has not yet been found in the province.

Piers (1894) published a brief note on some crickets collected at Windsor and later (Piers, 1896) issued an annotated list of 14 orthopteroid species collected near Halifax.

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*Presently at Macdonald College, Province of Quebec.

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Scudder (1899) also recorded *Orphulella speciosa* (Scudder) from Halifax, collected by Piers. Piers himself (1918) however, refuted this record also, but the species has since been found in the province (See below).

Further references to Nova Scotian Orthoptera did not appear until Gooderham (1917) published a paper listing 13 species of Acrididae, which he followed the next year with another publication containing information on six species of "Locustidae" (Tettigonoidea). (Gooderham, 1918).

In the same year, Piers (1918) published a monograph of Nova Scotian Orthoptera listing twenty-six species of Orthoptera (*sens. strict.*), two of which were hypothetical (thought likely to occur, but not collected) and two doubtful (the records from Scudder, (*11. cc.*)). Piers thus listed twenty-two species as being known from Nova Scotia but he also included notes on fifteen others which he thought might eventually be found. He predicted that the list of Orthoptera of Nova Scotia would not be expanded beyond thirty-five species.

Very little further appeared in print until J. W. H. Rehn (1939; 1939a) published notes on Orthoptera from Nova Scotia and Newfoundland. His first paper, based upon B. Long's collections of about 1920, added one species, *Melanoplus fasciatus* (Wlk.) to the list. This record was based on a single female. It confirmed the presence of a species which Piers (1918) has included as hypothetical.

In 1949, F. A. Urquhart collected in Nova Scotia. *Orphulella speciosa* (Scud.) was confirmed and a small cricket, *Nemobius palustris* Blatch., was also added to the list. *Zubovskya glacialis* (Scud.) was also confirmed by Urquhart from a collection by C. E. Atwood, but these records have so far remained unpublished.

Rehn and Grant (1958) included Nova Scotia in the range of *Tettigidea lateralis lateralis* (Say) from a single atypical specimen. This reference, from South Milford, Nova Scotia, is the first published record of this species from Nova Scotia. The locality marked on their distribution map is Milford, Colchester County, while South Milford is in Annapolis County.

During the present study, four more species were found. These are *Melanoplus keeleri luridus* (Dodge), *Chorthophaga viridifasciata* (De G.), *Neoconocephalus ensiger* (Harr.), and

Nemobius allardi Alexander and Thomas (1959), which is added since this species is described as distinct from *N. fasciatus* (De Geer). In addition to these, *Melanoplus fasciatus* (Wlk.) has been collected at various locations, confirming the presence of this species and adding to its known distribution. The distribution of many of the previously recorded species has been enlarged.

Thirty-one recorded species, and one of doubtful occurrence, in twenty genera are included in this paper as occurring in Nova Scotia, less than five per cent of the total number of species recorded from North America.

It is unfortunate that the whole insect collection, collection catalogue, and records at the Nova Scotia Agricultural College were destroyed by fire in 1946, and were not available for study. The only collection of Orthoptera of consequence in Nova Scotia is that which has been built up by the author and staff members at the Agricultural College since 1946 and supplemented by contributions from Dr. F. A. Urquhart, following his collecting trip in Nova Scotia in 1949.

The Canadian National Collection of Insects, Ottawa, has very few specimens of Orthoptera from Nova Scotia. Their records of this group from Nova Scotia, New Brunswick, and Prince Edward Island have been made available and are included in this paper.

II. PHYSICAL BACKGROUND AND ORTHOPTERAN DISTRIBUTION

Nova Scotia lies between 43 degrees and 47 degrees north-latitude and 59 degrees and 67 degrees west-longitude, with the axis running in a northeast-southwest direction. It is about 340 miles long and averages 50 miles in width. It consists of a peninsula, joined to the mainland (New Brunswick) by the swampy isthmus of Chignecto, and Cape Breton Island which is separated from the eastern end of the peninsula by the Strait of Canso. This island and the mainland are joined by a causeway which was completed in 1955. The province is divided into 18 counties, as shown on the map, Plate I.

The southern half of the province is called the Atlantic Upland, and is composed of rocks resistant to weathering, slates, quartzites and granites. (See Plate II —Fig. I). It is

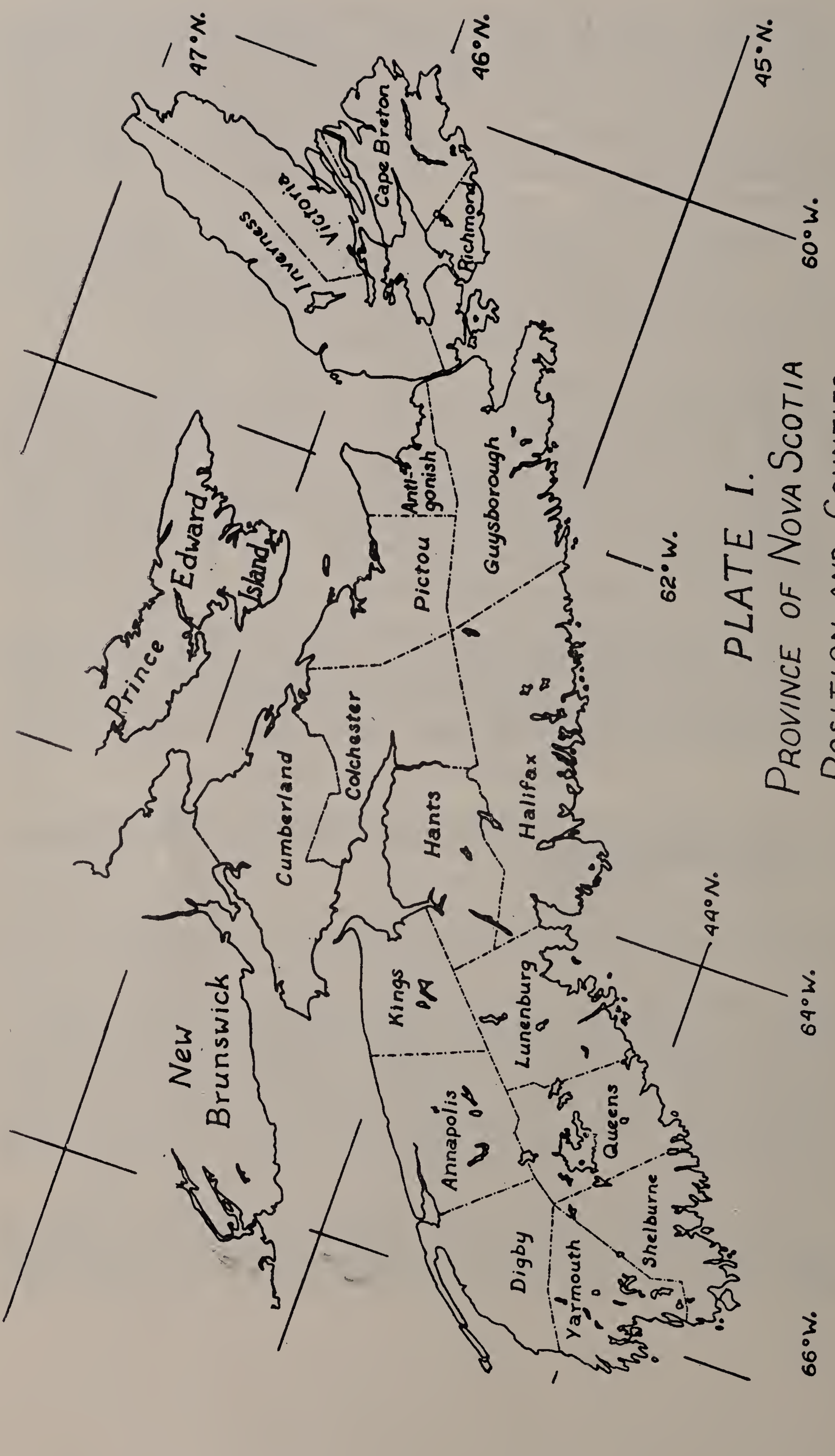


PLATE I.
PROVINCE OF NOVA SCOTIA
POSITION AND COUNTIES

PLATE II.

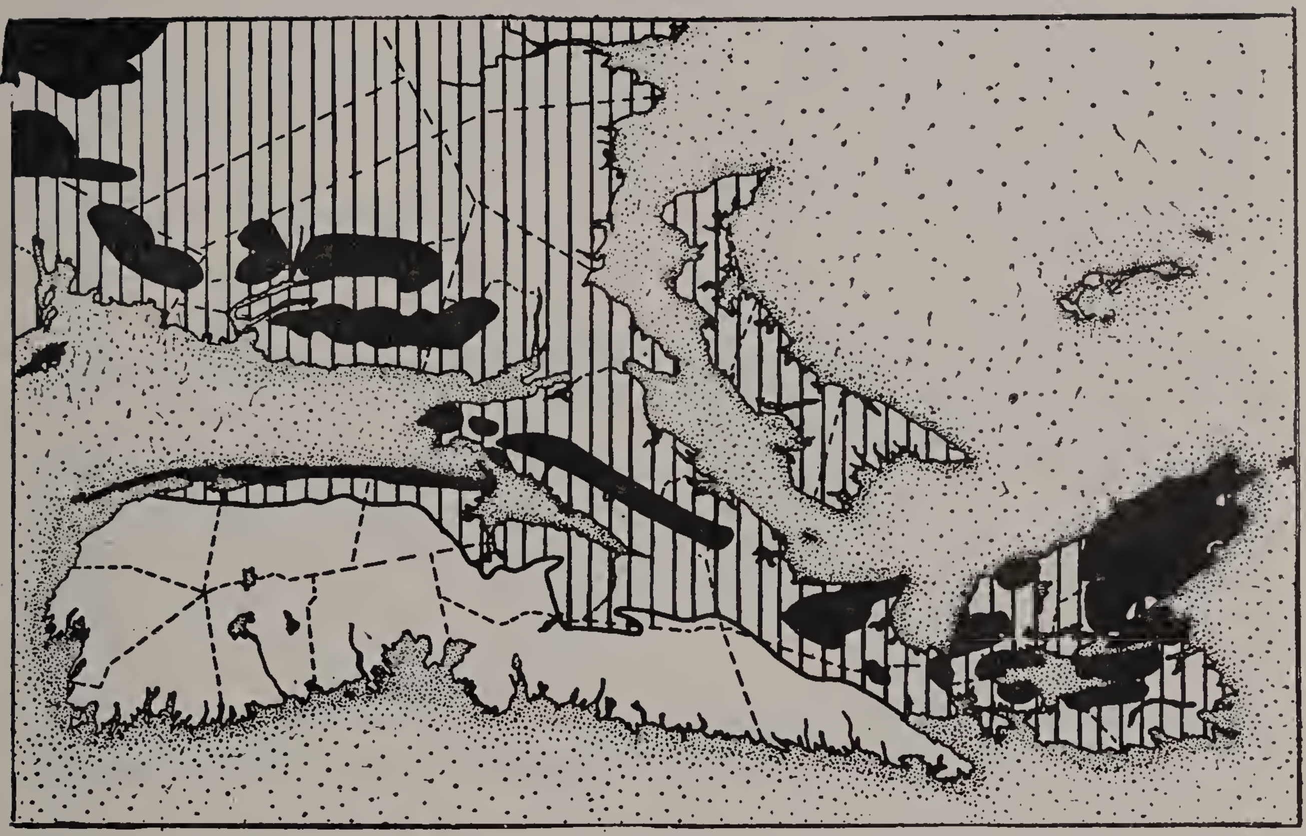


Fig. 1. Physiographic regions of Nova Scotia and adjacent areas: dark areas indicate true uplands; vertically hatched areas represent lowlands which vary considerably in basic structure; and the unshaded area indicates the so-called Atlantic Upland which basically is composed of rocks which are resistant to weathering and is generally poorly drained.

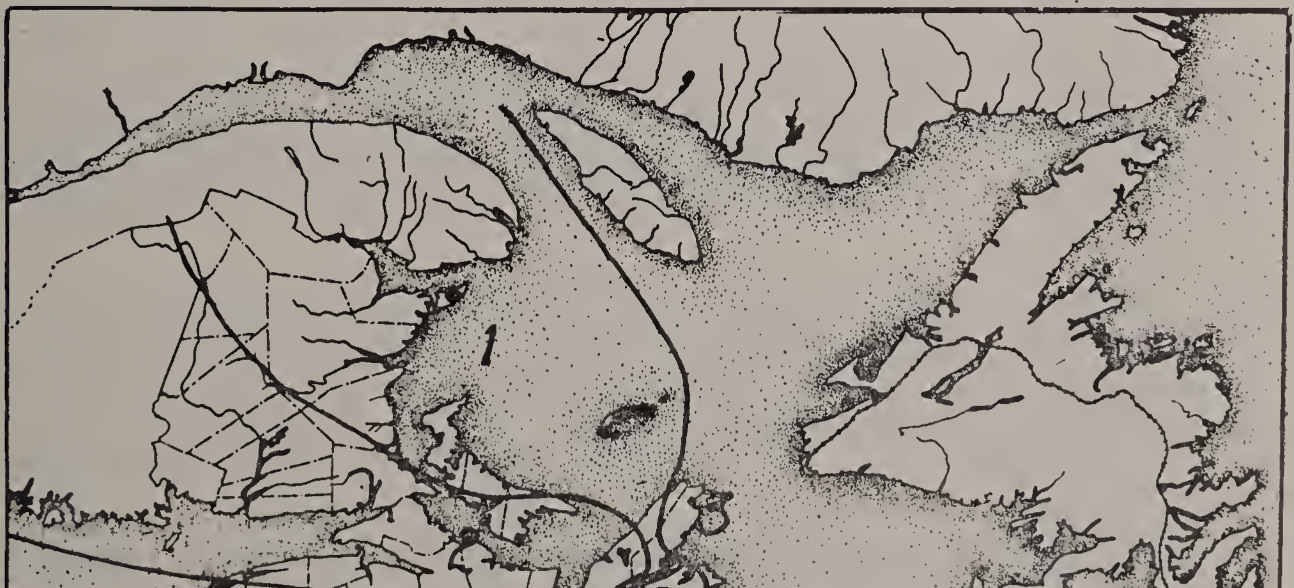


Fig. 2. Floral regions of Nova Scotia and adjacent areas: 1, predominantly Canadian Zone; 2, predominantly Alleghanian Zone; 3, predominantly Hudsonian Zone; and 4, coastal plains region.

not basically an upland but rises gently from sea-level to a height of 100 to 500 feet in the north. In the western half the three rock types appear in about equal proportions; i.e., the area comprising southern Yarmouth, Shelburne, Queens and Lunenburg Counties. In the eastern area granites and quartzites are predominant with slates nearly absent. Lakes, streams, bogs and barrens are very numerous in the Atlantic Upland area.

The true uplands are found in the northern half of Nova Scotia. The North Mountain extends from Kings County, at a height of 600 feet, in a southwest direction to dip beneath the sea at the end of Digby Neck. It is composed largely of basalt or trap rock. The ranges of hills from Cumberland County to Cape Breton are composed of igneous rocks, syonites, diorites and granites. These hills rise to 1000 feet and are covered with forest, mostly deciduous. The broad plateaux of northern Cape Breton are up to 1200 feet high and are very poorly drained. The plateaux are covered with bogs and trees and have a more severe climate than the rest of the province.

The remaining area is lowland which varies considerably. The Annapolis Valley is basically Triassic sandstone, while the northern and eastern lowlands have various mixtures of sandstones, shales, conglomerates, limestones and gypsum. In these areas deep valleys and rugged cliffs are found near the uplands and lakes and ponds are scarce.

The southwestern area has the longest frost-free period and the most foggy days, lower summer temperatures and higher minimum winter temperatures than the other regions. Cape Breton Island presents the other extreme, having a short growing season, very little fog and lower temperatures throughout the year.

Attempts have been made to divide the province into regions of the basis of distribution of insects; e.g., by Piers (1918) and Ferguson (1954). The species of Orthoptera are too few and the area is too small to establish definite regions on such a basis.

However, four general regions are indicated by the distribution of flora (Roland, 1944-45). The peninsula is roughly divided into three areas. The Coastal Plains region is made up of southwestern Yarmouth, Shelburne and Queens Counties and bears flora typical of the coastal plains of more southerly areas. The remainder of the mainland is divided into two regions by a line drawn between Annapolis and Guysborough. The region to the north of the line is mainly deciduous and representative of the Alleghanian Zone, while the poorly-drained area to the south of the line is representative of the Canadian Zone. Thus, in Nova Scotia, there exists a curious reversal, in that the southern floral elements are found in the north while the northern elements are found in the south.

The island of Cape Breton is considered separately. The Alleghanian Zone extends into the northwestern part and includes the Margaree Valley. The boggy plateaux of northern Inverness and Victoria Counties bear flora such as black spruce, fir, ericaceous plants and sphagnum, typical of a boreal zone. The remainder of the island is similar to the Atlantic Coast of the mainland and is classed as Canadian Zone. (Plate II, Fig. 2)

Piers (1918) listed two zones, Canadian and Alleghanian, into which the province of Nova Scotia was divided longitudinally. The Alleghanian Zone occupied the northern half of the mainland and the Margaree Valley of Cape Breton Island while the Canadian Zone included the remainder of Cape Breton Island and the Atlantic coast of the mainland. He mentioned the possibility of the northern tip of Cape Breton Island containing Hudsonian flora and fauna, so that his classification does not drastically differ from that of Roland (1944-45).

Actually, considerable variation occurs in all of these regions, with small areas in each apparently typical of another region. This is due largely to drainage and elevation of the areas concerned.

No species of Orthoptera is found solely in that part of Nova Scotia which lies within the Canadian Zone. Seven species, namely *Ceuthophilus maculatus*, *Neoconocephalus ensiger*, *Melanoplus keeleri luridus*, *Chorthophaga viridifasciata*, *Orphulella speciosa*, *Tettigidea lateralis*, and *Tetrix arensosa angusta* are found in the region representative of the Alleghanian Division of the Transition Zone. Of these seven species, the presence of three is incidental or accidental. *M. keeleri luridus* and *C. viridifasciata* are found only near the New Brunswick border and have probably moved into Nova Scotia during relatively recent years. *N. ensiger* is found only near the Greenwood airport and was presumably introduced recently by air.

The small cricket, *Nemobius palustris* has been found only in southwestern Nova Scotia and in the Halifax area.

All other species are either so common or found in such widely separated localities that they must be classed as "general" in distribution.

III. CLASSIFICATION OF NOVA SCOTIA ORTHOPTERA

ORDER ORTHOPTERA

Within the genera commonly grouped together under the name Orthoptera are found some of the most generalized insect types, but a relatively great divergence of form exists among them. Wings are variable, often vestigial or absent; where present, they consist of two pairs, the fore-wings or tegmina being thickened and parchment-like but with distinct venation, and the hind-wings often fan-like and usually folded beneath the tegmina when at rest; where wings are absent, the Orthoptera may be distinguished from other insects by the generalized biting or chewing mouthparts and the cleft labium. Stridulatory mechanisms are commonly found throughout the Orthoptera, reaching their highest development in the winged males of many species of grasshoppers and crickets.

Metamorphosis is gradual; normally, four to six nymphal instars occur. Although many Orthoptera are omnivorous and some are carnivorous, the great majority are phytophagous and some of them are of great economic importance.

Key to the Superfamilies Occurring in Nova Scotia

1. Antennae much shorter than the body; tarsi three-segmented; stridulation, when it occurs, usually by action of the legs or tegmina, or involving the hind wings; external ovipositor consisting of two pairs of short, pointed plates, diverging at tips. (Suborder Caelifera)........................2.

Antennae much longer than the body; tarsi three or four-segmented; stridulation, when it occurs, is usually by interaction of the basal areas of tegmina; ovipositor usually elongated, sword-, sickle-, or needle-like. (Suborder Ensifera) ....3.

2. Length less than 15 mm.; pronotum extending backward, tapering, to or beyond end of abdomen; tegmina represented by small, oval, lateral lobes.
................Family Tetrigidae, p. 36.

Length of adults 15mm. or more; pronotum not extending backward over abdomen; tegmina usually well developed, but sometimes abbreviated or wanting.
................Family Acrididae, p. 42.

3. Tarsi four-segmented; tegmina at rest lying roof-like over abdomen; ovipositor flattened, sword- or sickle-shaped; general colour green or brown..........................4.

Tarsi three-segmented; tegmina at rest lying flat above the abdomen with the sides bent abruptly downwards; ovipositor nearly straight, or slightly upcurved, needle-like; general colour brown to black.
..........Superfamily Grylloidea, p. 27.

4. Front tibia with slit-like auditory opening near the base.
..........Superfamily Tettigonoidea, p. 19.

Front tibia without auditory opening.
..........Superfamily Gryllacridoidea, p. 9.

Order Orthoptera
Suborder Ensifera
Superfamily Gryllacridoidea[1]
Family Rhaphidophoridae[2]

This family is characterized by the absence of wings; males are not known to stridulate; the pronotum is short, not covering the whole dorsal thoracic area; prosternal spines absent; ovipositor nearly straight; robust with arched back and a large head, which is bent downward between the forelegs. They are nocturnal, living in caves, or hiding under stones or logs in damp woods or along brooks. At least one species is commonly found in damp cellars. Eggs are laid in the soil in the fall and hatch during the spring. Rhaphidophorids (or "camel-crickets") are omnivorous feeders. They do not generally injure cultivated crops. *Tachycines asynamorus* (Adelung) has occasionally caused injury to seedlings in greenhouses on this continent and elsewhere (Hebard, 1934) but has not been reported in Nova Scotia. Only one genus, *Ceuthophilus*, is found in Nova Scotia.

---

[1] Some authors include this superfamily in the Tettigonoidea.

[2] Formerly regarded as a subfamily of Gryllacrididae.

Genus *Ceuthophilus* Scudder

Ceuthophilus Scudder, 1862. Bost. J. Nat. Hist. 7:433.

Key to Nova Scotia species of *Ceuthophilus*.

1. Males ....2.
Females ....3.

2. Hind margin of terminal dorsal segment of abdomen distinctly obtusely notched; hind tibiae distinctly bowed or curved on basal third. ....*C. maculatus*, p. 10.

Hind margin of terminal dorsal segment of abdomen entire, rounded; hind tibiae straight. ....*C. brevipes*, p. 11.

3. Carina of lower anterior surface of hind femora with many teeth; lower anterior margins of pronotum broadly bordered with brownish, general colour dark; hind tibiae darkened between spur bases; ovipositor 6.5 mm. to 7.5 mm. in length. ....*C. brevipes*, p. 11.

Carina of lower anterior surface of hind femora with few teeth; lower anterior margins of pronotum pale; hind tibia normally with a single subdistal ventral spur; ovipositor 6.8 to 9.5 mm. in length. ....*C. maculatus*, p. 10.

1. *Ceuthophilus maculatus* (Harris). Map 1; Fig. 3.

Rhaphidophora maculata Harris, 1841. Rpt. Ins. Mass.: 126.
Ceuthophilus maculatus. F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. 1: 201.
Onthophilus (*sic.* for *Ceuthophilus*) *maculatus*. F. Walker, 1872. Can. Ent. 4:30.

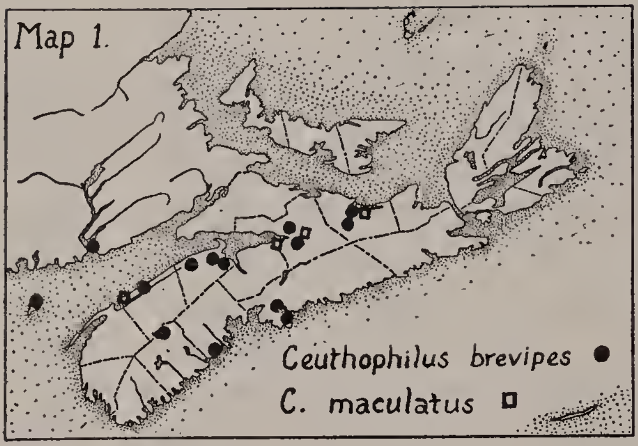
Ceuthophilus maculatus. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**: 31-32.
..........Piers, 1918. Trans. N. S. Inst. Sci. **14**: 326-327.
Common name — 'Spotted Camel Cricket'.

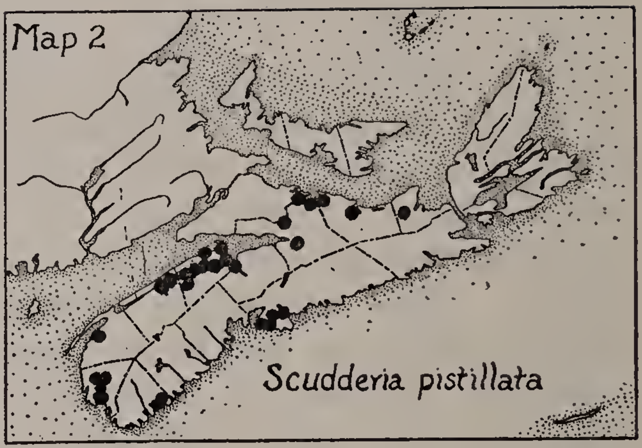
Body stout, back arched; antennae long; hind margin of terminal dorsal abdominal segment notched; fore femora often one-third or more longer than pronotum; hind femora broad; hind tibiae and hind femora of about equal length; lower carina of hind femur with 8 to 15 unequal, rather coarse spines. The colour is blackish-brown above, often with a lighter stripe on the dorsal part of the thorax; yellowish-brown beneath; dorsum of abdomen often bears a number of small, yellow dots; legs pale reddish-brown, the hind femora with brown bars. Body length, male 14 mm., female 16 mm.

The range of *C. maculatus* extends from the southern Canadian Zone to the northern half of the Upper Austral Zone. It is common in New England, but somewhat rare in Nova Scotia. It is found from mid-July to September under stones, beneath logs, and in hollow trees in dry open woods. It has been found at Truro, and Black Rock, Colchester County; New Glasgow, Pictou County; and at Granville Ferry, Annapolis County.

2. *Ceuthophilus brevipes* Scudder. Map. 1; Fig. 4.
Ceuthophilus brevipes Scudder, 1862. Bost. J. Nat. Hist. **7**:434.
Ceuthophilus terrestris. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:33.
..........Piers, 1918. Trans. N. S. Inst. Sci. **14**: 327-328.
Ceuthophilus brevipes. J. W. H. Rehn, 1939a. Fragm. faun. Mus. zool. Polon. **4**:264.
Common name — 'Woodland Stone Cricket'.

Body stout; back arched; antennae long; hind margin of terminal dorsal abdominal segment obtusely rounded; fore femora at least one-third longer than pronotum; hind femora broad and distinctly shorter than hind tibiae; outer lower carina with about 25 crowded, minute teeth; hind tibiae straight in both male and female. Colour reddish-brown; abdomen mottled with pale spots; light stripe on dorsal pronotum bordered by darker blotches often in evidence; legs lighter, hind femora with obscure dark bars. Body length, male 13-14 mm., female 14-15 mm.


Map 1.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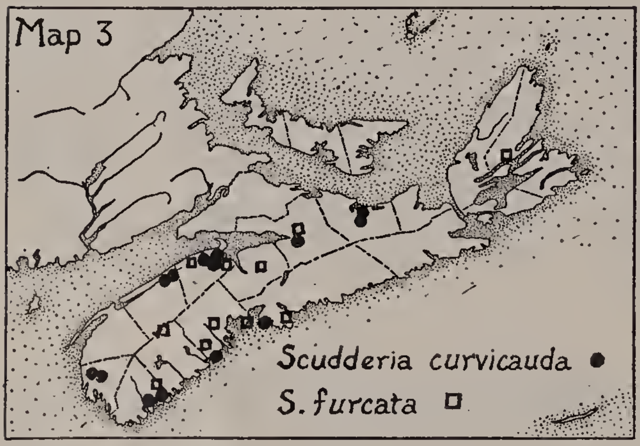
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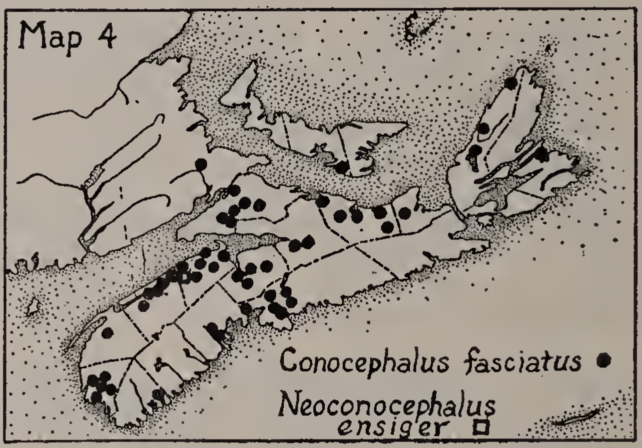
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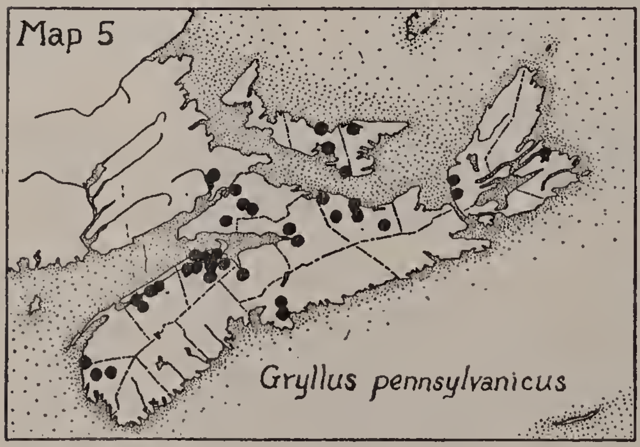
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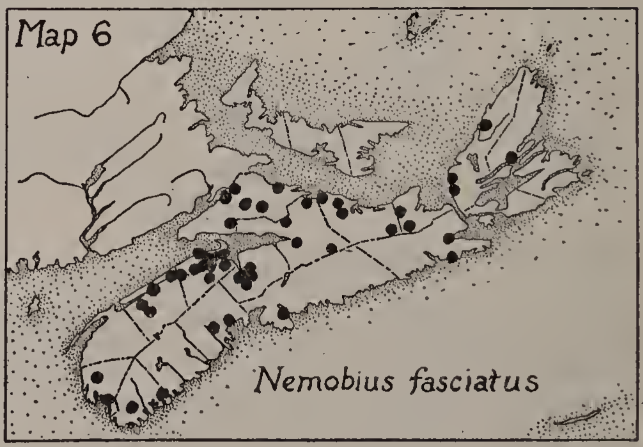
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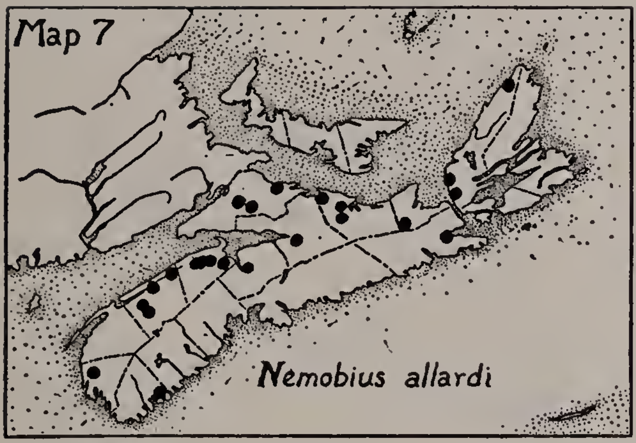
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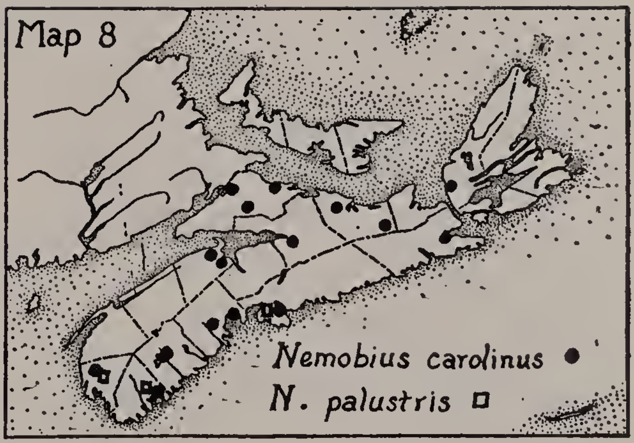
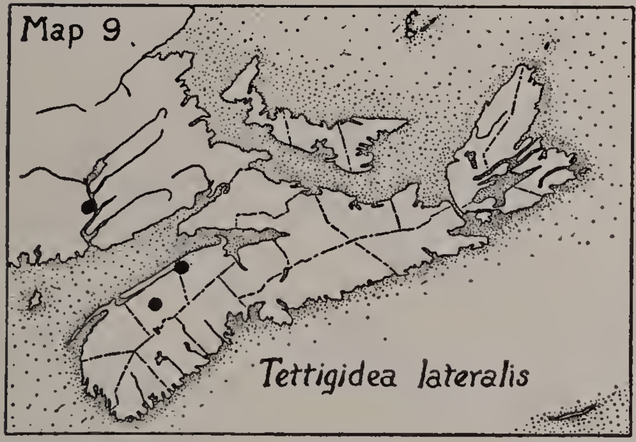
Nemobius allardi


Map 8
Nemobius carolinus ●
N. palustris □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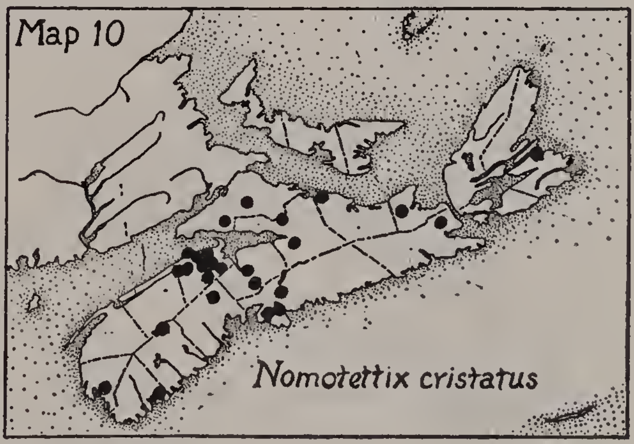
Tettigidea lateralis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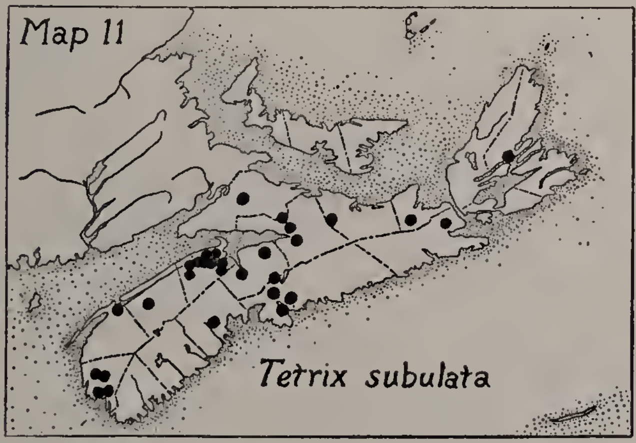
Nomotettix cristatus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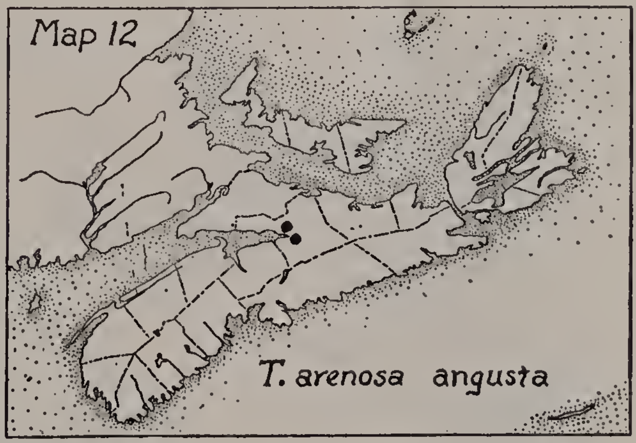
Tetrix subulata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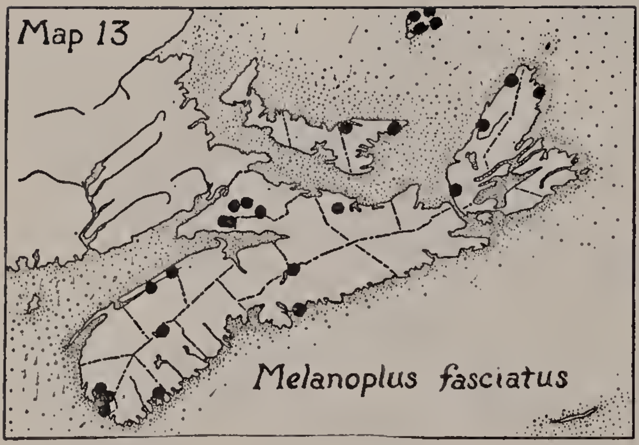
T. arenosa angusta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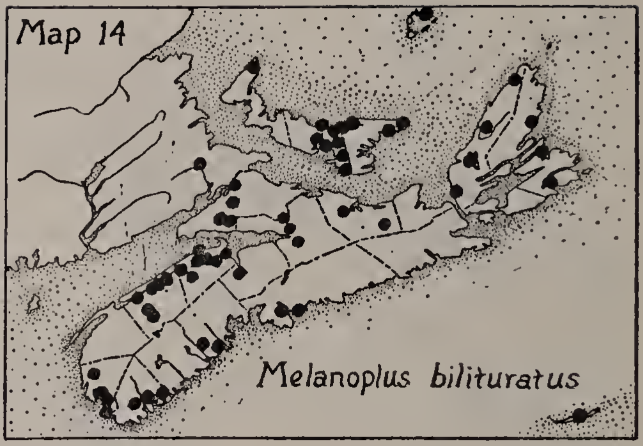
Melanoplus fasciatus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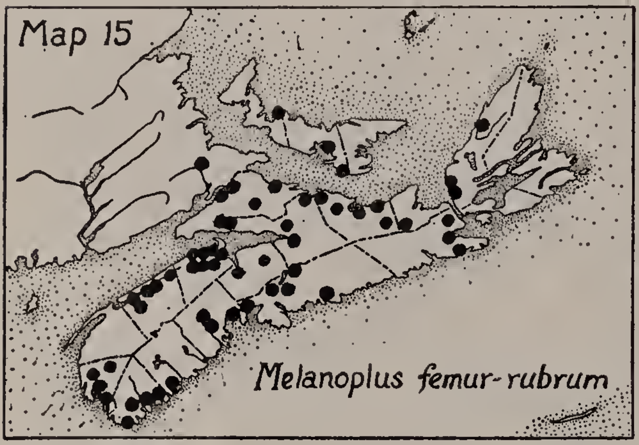
Melanoplus bilituratus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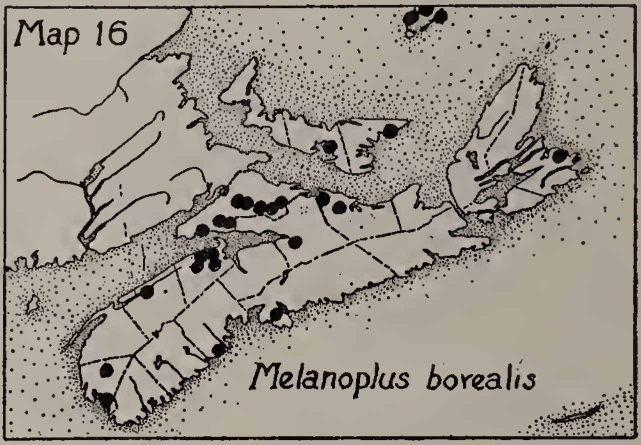
Melanoplus femur-rubrum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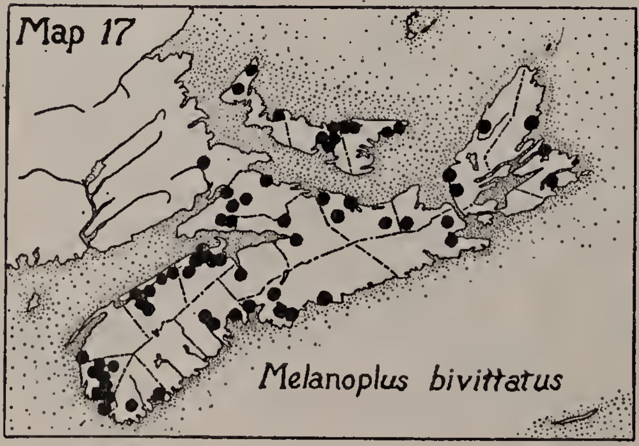
Melanoplus borealis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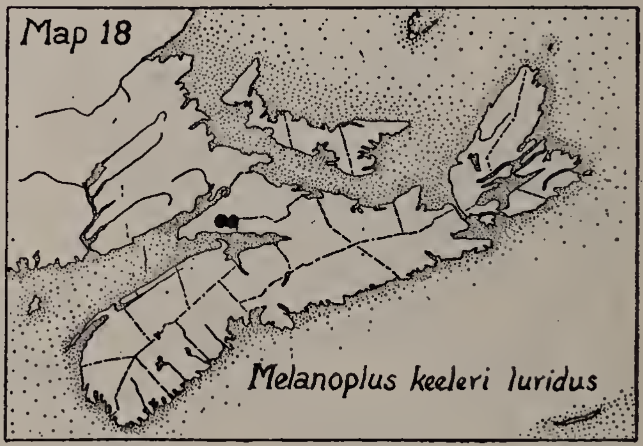
Melanoplus bivittatus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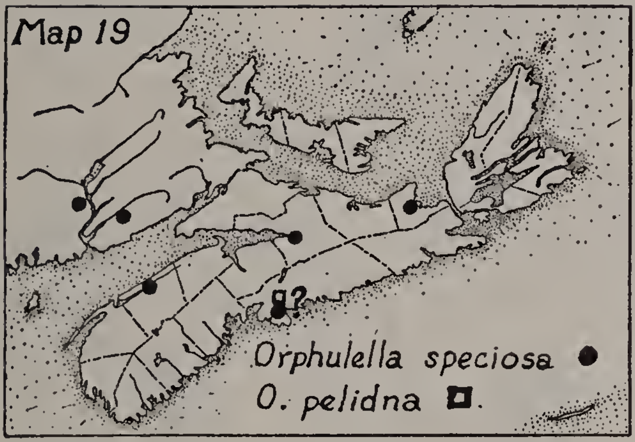
Melanoplus keeleri luridus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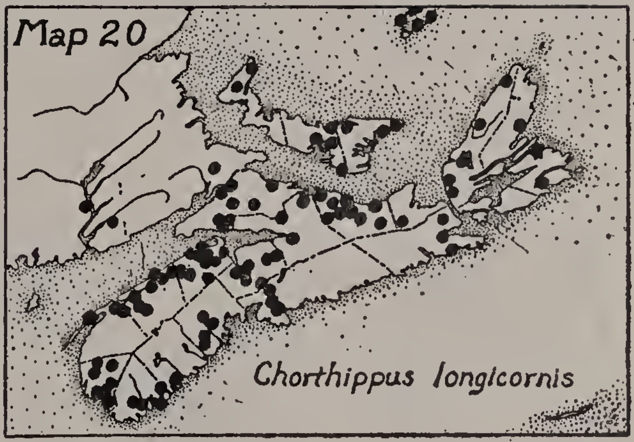
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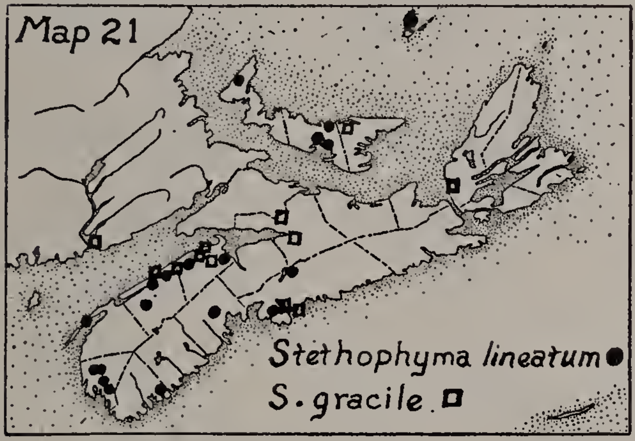
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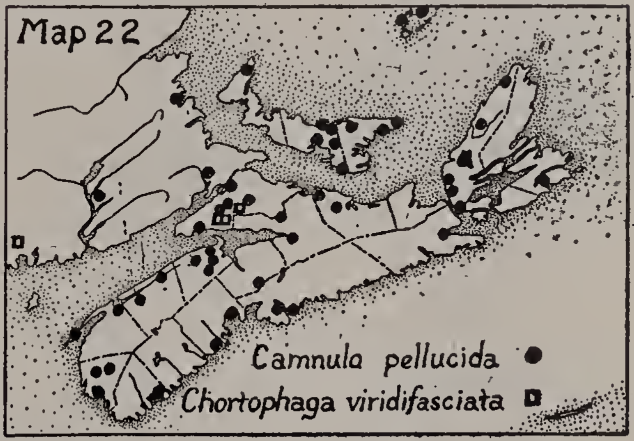
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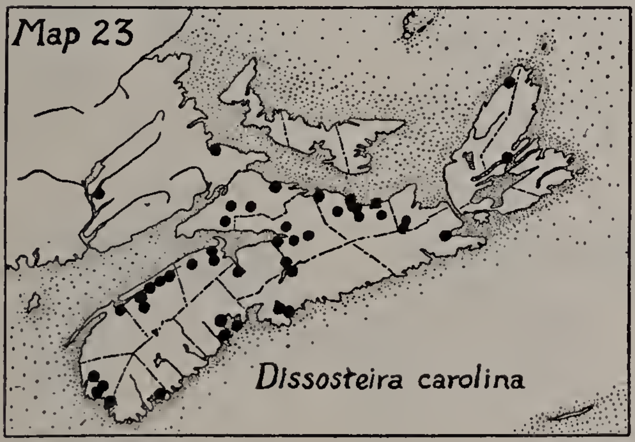
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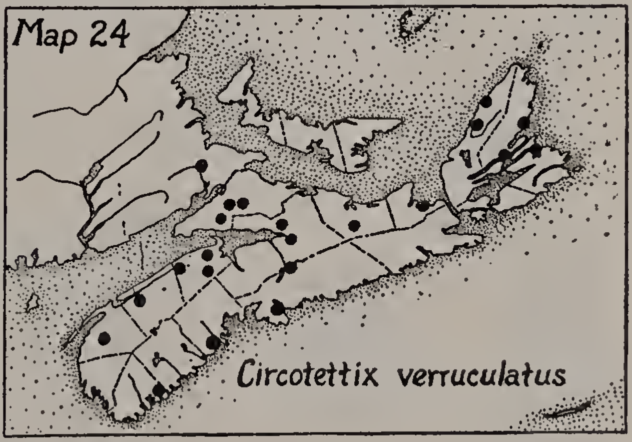
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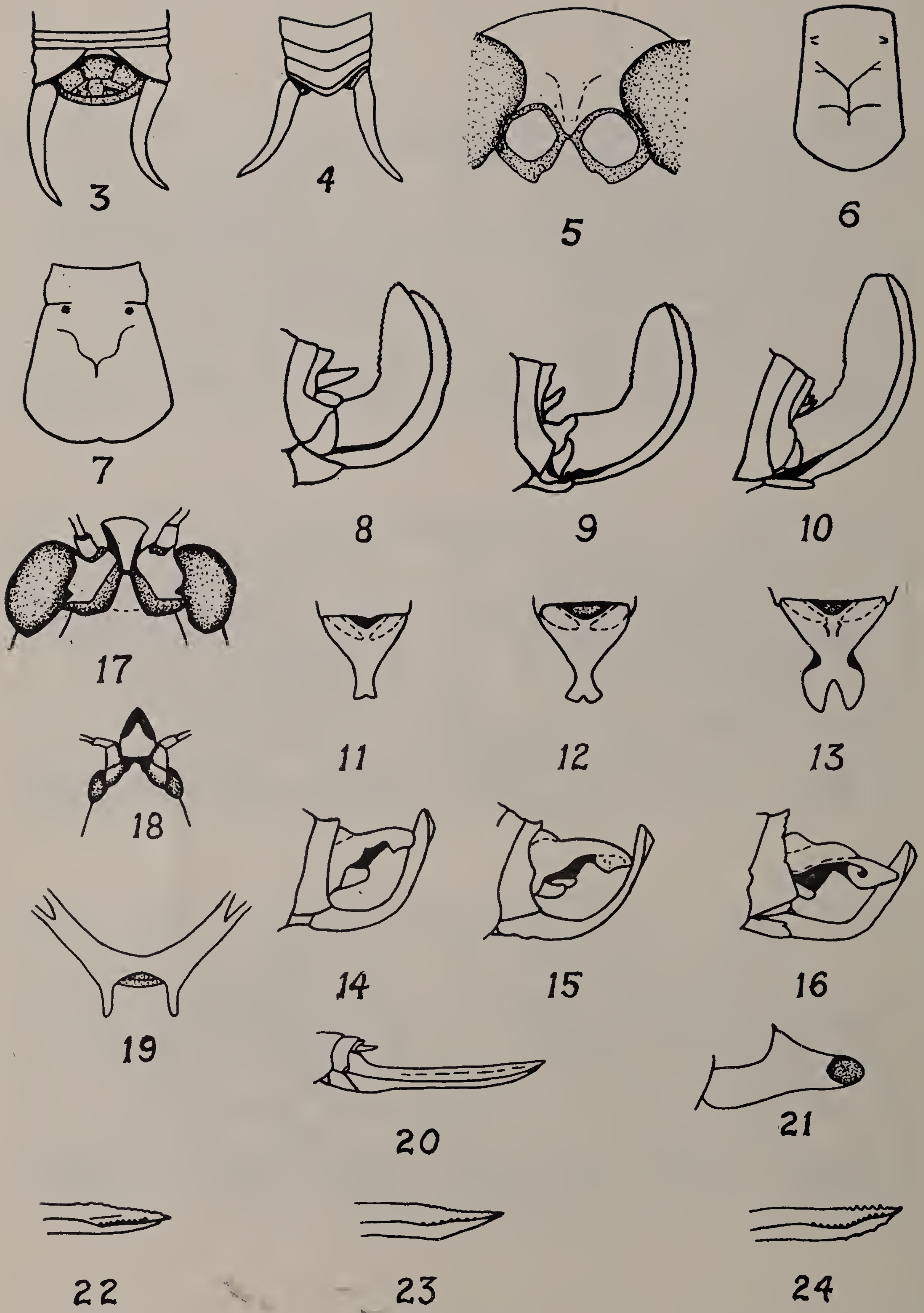
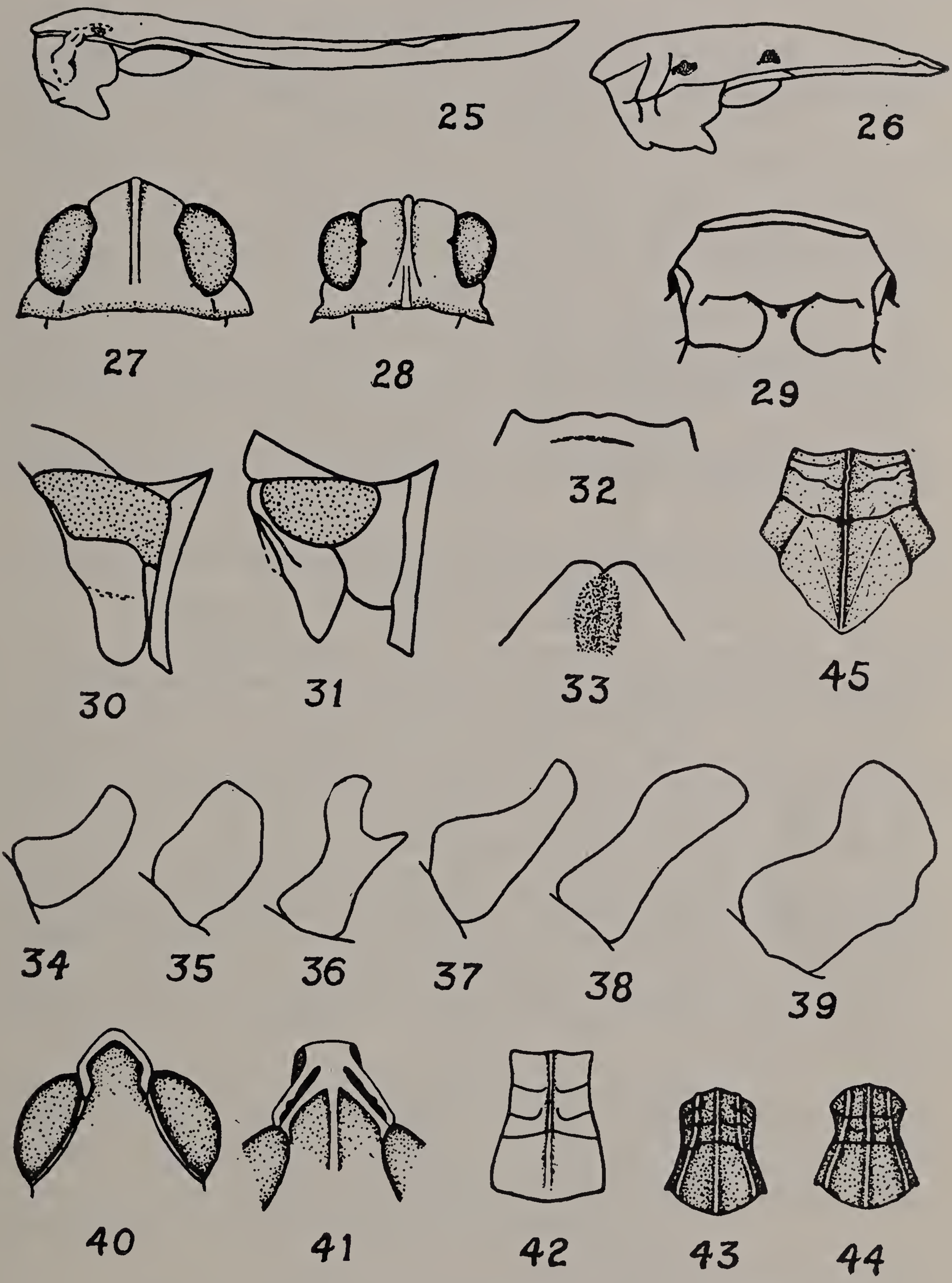


Figs. 3-24.



Figs. 25-45

Fig. 3. Posterior part of abdomen of *Ceuthophilus maculatus*, male, dorsal aspect.
Fig. 4. Same, of *C. brevipes*.
Fig. 5. Frontal fastigium of *Scudderia furcata*, anterior aspect.
Fig. 6. Pronotum of *Scudderia furcata*, female, dorsal aspect.
Fig. 7. Same, of *S. pistillata*.
Fig. 8. Ovipositor of *Scudderia pistillata*, female, lateral aspect.
Fig. 9. Same, of *S. curvicauda*.
Fig. 10. Same, of *S. furcata*.
Fig. 11. Supra-anal spine of *Scudderia pistillata*, male, dorsal aspect.
Fig. 12. Same, of *S. curvicauda*.
Fig. 13. Same, of *S. furcata*.
Fig. 14. Extremity of abdomen of *S. pistillata*, male, lateral aspect.
Fig. 15. Same, of *S. curvicauda*.
Fig. 16. Same, of *S. furcata*.
Fig. 17. Frontal fastigium of *Conocephalus fasciatus*, anterior aspect.
Fig. 18. Same, of *Neoconocephalus ensiger*.
Fig. 19. Prosternal spines of *Conocephalus fasciatus*, female, anterior aspect, head removed.
Fig. 20. Ovipositor of *C. fasciatus*, female, lateral aspect.
Fig. 21. Left cercus of *C. fasciatus*, male, dorsal aspect.
Fig. 22. Tip of ovipositor of *Nemobius allardi*, female, lateral aspect.
Fig. 23. Same, of *N. palustris*.
Fig. 24. Same, of *N. carolinus*.
Fig. 25. Pronotum of *Tetrix subulata*, lateral aspect.
Fig. 26. Same, of *Nomotettix cristatus*.
Fig. 27. Head of *T. subulata*, dorsal aspect.
Fig. 28. Same, of *T. arenosa angusta*.
Fig. 29. Mesosternal lobes of *Melanoplus bivittatus*, ventral aspect.
Fig. 30. Prosternal tubercle of *Melanoplus femur-rubrum*, lateral aspect.
Fig. 31. Same, of *M. bilituratus*.
Fig. 32. Subgenital plate of *Melanoplus femur-rubrum*, posterior aspect.
Fig. 33. Same, of *M. bilituratus*.
Fig. 34. Left cercus of *Melanoplus borealis*, male, lateral aspect.
Fig. 35. Same, of *M. bilituratus*.
Fig. 36. Same, of *M. keeleri luridus*.
Fig. 37. Same, of *M. femur-rubrum*.
Fig. 38. Same, of *M. fasciatus*.
Fig. 39. Same, of *M. bivittatus*.
Fig. 40. Head of *Orphulella speciosa*, dorsal aspect.
Fig. 41. Same, of *Chorthippus longicornis*.
Fig. 42. Pronotum of *Orphulella speciosa*, dorsal aspect.
Fig. 43. Same, of *Stethophyma lineatum*.
Fig. 44. Same, of *S. gracile*.
Fig. 45. Same, of *Dissosteira carolina*.

The range includes the eastern part of the Canadian and Transition Zones, in the northern United States and eastern Canada. It is usually found in similar locations to *C. maculatus*, but most of the specimens on hand were taken in damp cellars.

Nova Scotian records are from Truro and Debert, Colchester County; Kentville, Wolfville and Garland, Kings County; Clarence, Annapolis County; Lake Kedgemakoogie, Queens County; Petit Riviere, Lunenburg County; Armdale and Purcell's Cove, Halifax County; and Abercrombie and Hopewell, Pictou County. Piers (1918) also reported it from St. John and Grand Manan Island, New Brunswick. Hebard (1915) has recorded it from Newfoundland. The Zoology Museum, University of Michigan, Ann Arbor, Michigan, has a specimen from Nicholsville, Kings County, Nova Scotia.

Superfamily Tettigonoidea

Family Tettigoniidae (Sens. Lat.)

The group is characterized by the long filiform antennae, much longer than the body; four-segmented tarsi; tegmina, when at rest, held sloping, meeting in an acute ridge over the body; ovipositor sword or sickle-shaped, tip not expanded; stridulating organs, when present, situated just behind the pronotum, at the base of the overlapping dorsal area of the tegmina. Stridulation is brought about by parting the tegmina and bringing them together again, a vein of the upper surface of the right tegmen rasping against teeth of the stridulatory vein on the underside of the left tegmen. Winter is passed in the egg stage. The method of oviposition varies in the different groups.

Key to Nova Scotia Subfamilies of Tettigoniidae

1. Prosternum not spined; vertex rounded; tegmina broad and leaf-shaped; shorter than wings; hind tibiae with apical spurs on both inner and outer sides.
....................Phaneropterinae, p. 20.

Prosternal spines present; vertex projecting as a tubercle or cone; hind tibiae with no apical spines (or spine on outer side only)....................................2.

2. Vertex ending in a long, usually sharp cone; large (more than 23 mm.), robust; front and middle femora spined beneath.
.... Copiphorinae, p. 24.

Vertex ending in a rounded tubercle with concave sides; smaller (not more than 15 mm.), more slender; front and middle femora without spines beneath.
.... Conocephalinae, p. 26.

Subfamily Phaneropterinae

The members of this group live chiefly in bushes and small trees. They are solitary and slow moving, blending extremely well with their environment. Because of this, some species that are quite numerous are seldom seen. Eggs are glued in double rows to the surface of slender twigs or are inserted in the edges of leaves. The ovipositor is broad, curved, and obtuse at the apex. Stridulation notes are harsh and rasping, and are heard chiefly at night. Three species, all belonging to the genus *Scudderia*, are found in Nova Scotia.

Genus *Scudderia* Stål.

Scudderia Stål, 1873. Ofv. Vet. Akad.Fork. **30** (4); 41.

Key to Nova Scotia Species of *Scudderia*.

1. Males .... 2.
Females .... 4.

2. Notch of supra-anal spine rather shallow and V-shaped, the branches of the fork not swollen .... 3.

Notch of supra-anal spine very deep, well rounded or U-shaped, each branch of fork much swollen.
.... *S. furcata*, p. 23.

3. Ends of branches of supra-anal spine gently tapering; tegmina broad (over 8 mm.), and short, not more than four times as long as wide.
.... *S. pistillata*, p. 21.

Ends of branches of supra-anal spine subequal in width when viewed from above; tegmina narrower (under 8 mm.), and longer, nearly five times as long as broad.
.... *S. curvicauda*, p. 22.

4. Disc of pronotum with sides nearly parallel.
........................*S. furcata*, p. 23.
Disc of pronotum with sides distinctly widening posteriorly. ....**5.**

5. Tegmina relatively broad, over 8 mm., proportion — width: length — 1:3; eyes small.
....................*S. pistillata*, p. 21.
Tegmina relatively narrow, under 8 mm., proportion — width: length — 1:4½; eyes large.
....................*S. curvicauda*, p. 22.

3. *Scudderia pistillata* Brunner. Map 2; Fig. 7, 8, 11, 14.

Scudderia pistillata Brunner von Wattenwyl, 1878. Mon. der Phan.: 240.
?*Phaneroptera curvicauda.* F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. **2**: 335 (*nec.* De Geer).
?*Phaneroptera curvicauda.* F. Walker, 1872. Can Ent. **4**: 30 (*nec* De Geer).
Scudderia pistillata. Piers, 1896. Trans. N. S. Inst. Sci. **9**: 211.
........Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:26-28, 36.
........Piers, 1918. Trans. N. S. Inst. Sci. **14**:312-317.
........J. W. H. Rehn, 1939. Can. Ent. **71**:177.
Common name: "Broad-winged Bush-katydid".

Disc of pronotum distinctly broader posteriorly than anteriorly; tegmina broad and leaf-like, only three times as long as broad; supra-anal spine of male forked, the apical notch acute and shallow without a median tooth, and narrower than the upturned sub-anal spine; lateral flanges of notch subtriangular and distinctly tapering toward their ends, viewed from above; undersides of processes bearing small vertical longitudinal flanges or keels; hind femur of male 21 mm., of female 20 mm. Colour, pale apple-green above, whitish green below; antennae brownish, greenish basally; vertex of head white; dorso-lateral angle of pronotum with cream stripe; abdomen green; annular stripes of brighter on darker green on posterior margins of abdominal segments; two longitudinal raised white lines on ventral abdominal surface. Body length, male 19-23.5 mm., female 19-22 mm.

S. pistillata is common on bushes, mainly alders, in swampy locations. The loud stridulations of the males at dusk and after dark, on August nights, is a familiar sound in Nova Scotia. The call of *pistillata* is described "as a multi-pulse phrase in which the pulses are run together so that the human observer can only detect them clearly at low temperatures." (R. D. Alexander, personal communication, 1959). Irregularly timed, soft 'zik' sounds are heard during afternoons and at night. The significance of these sounds is not understood.

The range of this species includes the area from the southern part of the Canadian Zone to the northern part of the Upper Austral Zone, northern United States and southern Canada, east of the prairie.

The species is very common throughout Nova Scotia, much the most numerous of any species of *Scudderia.* It is recorded from Sutherland's Lake, Bayhead, Tatamagouche and Truro, Colchester County; Brule and Three Brooks, Pictou County; Brierly Brook, Antigonish County; Halifax, Goodwood Peggy's Cove and West Dover, Halifax County; Hantsport, Hants County; Delhaven, Canning, Kentville, Woodville, Waterville, Berwick, Aylesford and Millville, Kings County; Wilmot and Middleton, Annapolis County; Weymouth, Digby County; Yarmouth, Brooklyn, South Ohio and Deerfield, Yarmouth County; and Sable River, Shelburne County, from July 14 to October 21.

4. *Scudderia curvicauda* (De Geer). Map 3; Fig. 9, 12, 15.

Locusta curvicauda De Geer, 1773. Mem. Hist. Nat. Ins. 3:446.

Scudderia curvicauda borealis. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:28-29.

........Piers, 1918. Trans. N. S. Inst. Sci. **14**:317-320.

........J. W. H. Rehn, 1939. Can. Ent. **71**:178.

Common name: 'Curve-tailed Bush-katydid'.

This species resembles *S. pistillata* but is distinguished by features as given in the key to species of *Scudderia.* It has narrower tegmina, larger eyes, and somewhat longer hind femora (20-22.5 mm. as compared with 20-21 mm. in *S. pistillata*); it also has a smaller tympanal area on the male tegmen;

and the branches of the fork of the male supra-anal spines are subequal in width. The colour is generally a uniform green; lateral angles of pronotum weakly outlined in brownish-white. Body length, male 18-22 mm., female, 18-20 mm.

The subspecies *S. c. borealis* Rehn and Hebard (1915), rather than typical *S. c. curvicauda* was generally considered to be represented in Nova Scotia. Blatchley (1920) doubted the justification of recognizing *borealis* solely on the basis of the smaller size and broader and shorter tegmina, but the subspecific name became widely used. It is not now considered to be a valid subspecies.

This species is frequently heard in daylight hours in Nova Scotia. The call is similar to that of *S. pistillata* but is delivered much more slowly. The individual pulses are detectable and can be counted; usually 3 or 4 pulses are given for each phrase. Observations of the call of *S. curvicauda* were not unlike the descriptions given by Piers (1918) as 'bzrwi' by day and a repeated 'tchw' by night.

S. curvicauda is not nearly as common as *S. pistillata* but appears to be generally distributed in Nova Scotia. It has been collected at Stellarton and Three Brooks, Pictou County; Truro, Colchester County; Kentville, Waterville and Canard, Kings County; Melvern Square and Wilmot, Annapolis County; South Ohio and Deerfield, Yarmouth County; Jordan Falls and Sable River, Shelburne County; Green Bay, Lunenburg County; and Peggy's Cove, Halifax County, from August 15 to October 12.

5. *Scudderia furcata furcata* Brunner. Map 3; Fig. 5, 6, 10, 13, 16.

Scudderia furcata Brunner von Wattenwyl, 1878. Mon. der Phan.:239.
?*Phylloptera myrtifolia*. F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. 2:376. (*nec* Serville).
........F. Walker, 1872. Can. Ent. 4:30 (*nec* Serville).
Scudderia furcata. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:28, 30.
........Piers, 1918. Trans. N. S. Inst. Sci. **14**:320-323.
Common name — 'Fork-tailed Bush-katydid'.

Disc of pronotum with sides nearly parallel; tegmina narrow, with proportions width to length, 1:4½ in males; 1:4⅝ in females; supra-anal spine of male deeply forked, apical notch deep and U-shaped, without a median tooth, lateral processes decidedly swollen, broadest at the base; and not much longer than broad; hind femora 17.5 to 22 mm. Colour dark leaf-green, occasionally more or less suffused with brown; head and pronotum paler, lateral outlines of pronotum not outlined with yellowish. Body length, male, 14-18 mm., female 18-22 mm.

S. furcata, according to Allard (1911), calls less often at night than during the afternoons. It calls only at long and irregular intervals, and then produces a single keen 'zeep', or two or three, slowly, in succession, 'zeep, zeep, zeep'. Stridulation of *S. furcata* in Nova Scotia has been observed on several occasions. Each time the call was heard at night and consisted of a single phrase of sound, like 'zeeep'.

This species is of more generally southern distribution than the other species common in Nova Scotia. It is found in southern Canada and in most of the United States, from Nova Scotia to Florida and west to Texas, Nebraska, South Dakota, and Ontario.

S. furcata is rather scarce in Nova Scotia except along the southwestern shore, where it is the dominant species of *Scudderia*. The collection at the Nova Scotia Agricultural College has specimens from Onslow, Colchester County; Rawdon, Hants County; Kentville and Berwick, Kings County; Sable River, Shelburne County; Lake Kedgemakoogee, Queens County; and Middlewood, Lunenburg County. Piers (1918) reported this species from Halifax and the Canadian National Collection has specimens labelled *Scudderia* (prob. *furcata*), from Bridgewater, and White Point Beach, Lunenburg County, and from Baddeck, Victoria County.

Subfamily Copiphorinae

This subfamily contains rather large elongate species with the vertex of the head terminating in a spine, often with a ventral tooth-like projection; antennae long; ovipositor long, straight, slender and sharp-pointed. The males stridulate like the katydids. The eggs are laid in plant material.

Genus *Neoconocephalus* Karny.

Neoconocephalus Karny, 1907. Abr. Zool. Bot. Gessells. Wein. **4**(3) :22.

Only one species of this genus, *N. ensiger*, is established in Nova Scotia, although an interesting introduction of another occurred in 1958. A living specimen of *Neoconocephalus*, which had been found in macaroni, packaged in the southern part of the United States, was brought to Mr. D. C. Ferguson of the Nova Scotia Museum of Science, Halifax. It proved to be *N. robustus* (Scudder). It was maintained alive at the Museum for more than a month.

6. *Neoconocephalus ensiger* (Harris). Map 4; Fig. 17.
Conocephalus ensiger Harris, 1841. Rpt. Ins. Mass.: 131.
Common name — 'The Sword Bearer'.

Generally elongated, slender; fastigium slender, slightly constricted in front of the eyes, narrowed from the middle forward, tooth projecting downward from front of base; pronotum with lateral carinae feebly divergent, disc finely punctate; humeral sinus shallow, very broadly rounded; tegmina narrow and much longer than the body; stridulating vein of male long and feebly swollen; female ovipositor long, straight and pointed. Colour grass-green (usually fading to dull yellow on drying); margins and tip of lower face of fastigium black, the tooth green; lateral carinae of pronotum often yellowish; tarsi, hind tibiae and tip of ovipositor somewhat infuscated. Body length, male, 24-26 mm., female, 28-30 mm.

N. ensiger stridulates only at night or during cloudy weather. Allard (1911) reports this call as consisting of an intermittent but brisk 'tsip- tsip-tsip-tsip', which continues indefinitely and lacks the harshness characteristic of *Scudderia* spp. No opportunity to study the stridulation of this species was encountered during the present study.

This species has a very wide distribution, from Nova Scotia, Maine, Southern Ontario, North Dakota and south and south-east to North Carolina, Tennessee, Kansas and New Mexico. It frequents tall grasses along ditches, fields, roadsides, etc. The present record, the first for Nova Scotia, shows *N. ensiger* to be very localized in distribution, having been taken at only one site. This is near the Royal Canadian

Air Force Station, Greenwood, probably introduced by aircraft. Three specimens are to hand, all males taken at Millville, Kings County, one on August 13, 1954 and the other two on August 19, 1954.

Subfamily Conocephalinae

Members of this subfamily are superficially very similar to the Copiphorinae but are considerably smaller; vertex of the head terminating in a tubercle, usually blunt. The males stridulate but the notes are very soft and low and are heard both day and night. The eggs are deposited between the stems and root-leaves of grass or in the pith of twigs, etc.

Genus *Conocephalus* Thunberg.

Conocephalus Thunberg, 1815. Mem. Acad. Impt. Soc. St. Petersburg, **5**:271.

Conocephalus fasciatus (De Geer) is the only species of this genus found in Nova Scotia. It was expected that *C. brevipennis* Scudder might occur but it was not located within the study area.

7. *Conocephalus fasciatus fasciatus* (De Geer). Map 4; Fig. 18, 19, 20, 21.

Locusta fasciatum De Geer, 1773. Mem. Hist. Nat. Ins. **3**:458.
Xiphidium fasciatum. F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. **2**:270.
........F. Walker, 1872. Can. Ent. **4**:30.
........Piers, 1896. Trans. N. S. Inst. Sci. **9**:213.
Conocephalus fasciatus. Gooderham, 1918. Proc. Ent. Soc. N. S. for **1917**:24-25.
........Piers, 1918. Trans. N. S. Inst. Sci. **14**: 324-325.
Conocephalus fasciatus fasciatus. J. W. H. Rehn, 1939. Can. Ent. **71**:178.
........J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:204.
Common name — 'Slender Meadow Grasshopper'.

Very slender, delicate species; vertex of head extends forward and slightly upward as a rounded tubercle with concave sides; antennae long; prosternal spines short and weak; tegmina narrow, straight, and extending well beyond the abdomen; wings slightly longer than tegmina; ovipositor slender, straight, and about two-thirds as long as the hind femora; hind legs long and slender, femora and tibiae about equal in length. The colour is a translucent light apple-green, finely sprinkled with brown on face, sides of head, pronotum and legs, those on the hind femora arranged in longitudinal lines; a dark brown dorsal stripe extends from vertex to end of abdomen, narrow on head, wider on abdomen; sides of abdomen brown; tegmina greenish white to yellowish, with a brownish-red blotch on the lateral basal part, this colour extending to the veins; hind femora green with apical third fawn; hind tibiae light fawn, spines tipped with black; Body length, male 12-13.5 mm., female 12-14.5 mm.

The stridulation of *C. fasciatus*, according to Allard (1911) consists of faint, staccato lisps preceding a long drawn out note, like 'tip-tip-tip-tseeeeeee'. The preceding lisps usually number from three to six, and are so faint they may easily be missed. The stridulation in Nova Scotia conforms very well to this description.

The range of this subspecies is very wide, all over the United States and southeastern Canada from the Rocky Mountains east to the Atlantic, and southward into Mexico. It is very common all over Nova Scotia. It prefers tangles of weeds and grasses bordering fields and often is found in large numbers. The earliest and latest dates of collection in Nova Scotia are July 18 and September 22. E. M. Walker (1915) reported *C. fasciatus* from Moncton, New Brunswick and Urquhart collected it at Wood's Island, Prince Edward Island, in 1949.

Superfamily Grylloidea

Family Gryllidae

This family includes all the true crickets found in Nova Scotia. The filiform antennae are much longer than the body and the tegmina lie flat above the body, bent abruptly downward at the sides; hind femora stout, tarsi three-segmented; ovipositor straight or up-curved, needle-like, with the tip often enlarged; the stridulating organ, when present, is large, extending across the proximal portion of both anal and median areas of the tegmina; the hind wings are often of little use in flight and may be considerably reduced. Eggs are laid in the ground and winter is passed in the egg stage in species occurring in Nova Scotia, although hibernation of nymphs is common in other species and in other parts of the world. Many species of Gryllidae are grass feeders and may cause considerable damage to grassland.

Key to Nova Scotia Subfamilies and Genera of Gryllidae

Species small (body length less than 12 mm.); last segment of maxillary palp twice the length of the preceding segment; hind tibiae with long, moveable, pilose spines; first segment of hind tarsus without teeth or with one row of small teeth.

............Nemobiinae, *Nemobius*, p. 31.

Species large (body length more than 12 mm.); last segment of maxillary palp little if any longer than the preceding segment; hind tibiae with strong, immoveable spines; first segment of hind tarsus grooved above, with two rows of teeth.

Gryllinae, *Gryllus*, p. 28.

Subfamily Gryllinae

This subfamily contains robust crickets of medium to large size; head large, eyes prominent; pronotum broader than long; hind tibiae armed above on each side with five to eight stout spines and three pairs of unequal apical spurs; ovipositor as long or longer than hind femora, apex enlarged but not serrulate.

Genus *Gryllus* Linnaeus.

Gryllus Linnaeus, 1758. Syst. Nat. ed. **X**:425.

Uvarov (1935) erected the genus *Gryllulus*, with the type species *G. domesticus* (L.), to define the limits of a group of species, originally included under *Gryllus* Linnaeus, in its modern sense. Roberts (1941) pointed out that the name *Acheta* Fabricius, 1775, was available and had priority over *Gryllulus*. The use of this name *Acheta* in place of *Gryllulus* was established by Gurney (1950). However, Randell (in manuscript) has shown that common North American species differ markedly from *A. domesticus* (Linn.), type species of *Acheta*, and are properly included under *Gryllus*, as they are more closely related to *G. campestris* Linn., type species of *Gryllus*.

8. *Gryllus pennsylvanicus* (Burmeister). Map 5.
Gryllus pennsylvanicus Burmeister, 1838. Handb. Ent. **2**:734.
Acheta abbreviata. Piers, 1894. Trans. N. S. Inst. Sci. **8**:410.
Gryllus pennsylvanicus form *neglectus*. Piers, 1896. Trans. N. S. Inst. Sci. **9**:210.
Gryllus assimilis. Rehn and Hebard, 1915. Proc. Acad. Nat. Sci. Philad. **67**:293. (partim, *nec* Fabricius).
Gryllus assimilis form *neglectus*. Piers, 1918. Trans. N. S. Inst. Sci. **14**:341-354.
Gryllulus assimilis. J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:264.
Common name — 'Northern Fall Field Cricket'.

Size small to medium; width of abdomen about one-third body length; head nearly same in width as pronotum; pronotum half again as wide as long, little if any narrower behind, front margin slightly concave, hind margin slightly convex; tegmina of female usually covering three-fifths to four-fifths of the abdomen, never longer than the abdomen; tegmina in male usually nearly covering abdomen, rarely slightly longer; inner edges of tegmina overlap for entire length in male, but may be somewhat separated in female at the ends to form an inverted V-shaped notch. Colour generally black, often with fine grey pubescence on the pronotum, femora and some other parts; head shining black; tegmina shining black with a light coloured line; ovipositor brownish; femora with brownish areas on inner and outer faces. Body length, male 15-21 mm., female 14.7-23.7 mm.

Allard (1911) made the observation that this species stridulates incessantly in sunshine, emitting a brief, intermittent, musical 'chirp, chirp, chirp'. This is certainly true of specimens in Nova Scotia but stridulation is by no means confined to the daylight hours.

Fulton (1952) carried out a comprehensive study of the North Carolina field crickets making up the complex, known since the revision of Rehn and Hebard (1915) as *Gryllus assimilis* (Fabr.). Fulton concluded, on the basis of differences in ecology, distribution, life history and song, that this complex included four valid North Carolina species.

Alexander (1957) pointed out that *assimilis* (Fabr.), 1775, was described from Jamaica and found that specimens from Jamaica were morphologically different from those of the eastern United States, so that Fabricius' name *assimilis* should not be applied to the northern forms. The next valid name is *pennsylvanicus* Burmeister, 1838.

In the eastern United States, and in Quebec, two distinct seasonal populations exist: one which over-winters in the late nymphal stages, with adults present from May until early August; and another which over-winters in the egg and is present in the adult condition from August to October. This was recognized by Criddle (1925) in Manitoba, when he called the spring cricket *Gryllus assimilis pennsylvanicus* Burm. and the autumn cricket *G. a. luctuosus* Serville.

No spring-maturing crickets have been found in Nova Scotia during the twelve years that the author has been collecting Orthoptera there. No crickets have been heard before early August, except in very sheltered locations. Piers (1918), who collected Orthoptera for twenty-four years before that date, made the following statement, "I have never noted crickets in the spring or early summer, as in Ontario and other places to the south where nymphs hibernate to some extent." (p. 353). No *Gryllus* specimens have been found in the adult condition before July 29 (these were in a sheltered location) during the present study.

The absence of the spring field cricket in Nova Scotia proves the theses of Alexander (1957) and Bigelow (1958) to be correct; the spring and fall field crickets are distinct species. Alexander and Bigelow (1960) have named the spring species *G. veletis*. The fall maturing species, occurring in Nova Scotia, is *G. pennsylvanicus* (Burm.).

This species is common in Nova Scotia from early August to October. It has been collected from August 2 to November 5 from the following points: Amherst, Collingwood, West Brook and Wyndhamhill, Cumberland County; Truro and Debert, Colchester County; Pictou, West River, Westville, Brule and Garden of Eden, Pictou County; Windsor, Hants County; Kentville, Wolfville, Berwick, Black Hole, North

Alton, and Aylesford, Kings County; Bridgetown, Le Quille, and Paradise, Annapolis County; Beaver River, Digby County; South Ohio and Kemptville, Yarmouth County; Bedford and Halifax, Halifax County; Judique and Creignish Mountain, Inverness County; and from Dorchester, New Brunswick.

Rehn (1939a) recorded it from North Sydney and Annapolis Royal, as well as from some of the above mentioned localities.

Urquhart supplied five specimens, three males and two females from Windsor and Pictou, labelled *Gryllulus assimilis luctuosus*, to the Nova Scotia Agricultural College insect collection in 1949. He also collected this species at Wood's Island, Prince Edward Island. E. M. Walker (1915) reported it from Brackley Point, Charlottetown and Dundee, Prince Edward Island.

Subfamily Nemobiinae

Small, compact species; body and legs usually covered with long hairs; ocelli small, round, and arranged in a triangle; eyes oval, prominent; pronotum slightly broader than head; tegmina of males usually shorter than abdomen, tips rounded or subtruncate; tegmina of females with few prominent longitudinal veins and numerous small cross veins; hind wings variable, often absent; hind femora swollen; cerci of both sexes slender, tapering, hairy, and about one-half as long as the femora; ovipositor variable.

These crickets are often gregarious, and unlike the Gryllinae, feed during daylight. They are omnivorous, and according to Blatchley (1920) feed "upon carrion, cow dung, and grasses with equal avidity". As they are usually very numerous they may cause considerable damage to grasses.

Genus *Nemobius* Serville.

Nemobius Serville, 1839. Hist. Nat. Ins. Orth :345.

Key to Nova Scotia Species of *Nemobius*

1. Lower pair of apical spurs of hind tibiae unequal in length, inner one much longer; apex of ovipositor of female with only upper margin more or less finely serrulate. ....2.

Lower pair of apical spurs of hind tibiae equal in length; apex of ovipositor of female with both upper and lower margins serrulate, teeth of lower margin very fine and widely spaced, teeth of upper margin coarse; general colour pale brown; last two joints of maxillary palpi partially but not wholly white.

.... *N. carolinus*, p. 35.

2. Ovipositor short, about two-thirds as long as hind femora, weakly but evidently curved; wings usually present and usually longer than abdomen; ovipositor armed with fine, close-set teeth; general colour dark brown to uniform piceous, occiput without longitudinal stripes; body length of male rarely over 6 mm.; habitat — sphagnum bogs.

.... *N. palustris*, p. 35.

Ovipositor longer than or nearly as long as hind femora, straight or nearly so; teeth of upper margin of apex fairly coarse; occiput with four dark longitudinal stripes, varying from distinct to nearly obsolete; general colour black to dark brown; males 7.5 mm., females 8-10 mm. in length.

....3.

3. (Adapted from Alexander and Thomas, 1959, p. 600)

Head colouration showing distinct, dorsal, longitudinal dark and lighter stripes; head wide and well rounded, pronotum barrel-shaped so that head and front edge of pronotum are as wide or wider than rear edge of pronotum; ovipositor shorter, 5.9 to 10 mm. (over 7.5 mm. only in specimens with head width behind eyes over 2.6 mm.); stridulatory vein on right tegmen of male with 100 to 150 teeth, portion inside ulnar vein less than 1.0 mm. long and less than one-third as long as width of head behind the eyes; generally found in moist situations; song a steady repetition of short buzzing chirps, like ‘bzzzt, bzzzt, bzzzt’.

.... *N. fasciatus*, p. 33.

Dorsal striping of head indistinct; head narrow and retracted, pronotum narrower in front, so that head and front edge of pronotum is narrower than rear edge of pronotum; ovipositor longer, 6.0 — 10.3 mm.; head width behind eyes not over 2.8 mm.; stridulatory vein on right tegmen of male with more than 160 teeth, portion of vein inside ulnar vein usually more than 1.0 mm. and more than two-fifths as long as width of head behind eyes; found in dry or moist areas; song a rapid trill, like ‘ti-ti-ti-ti-ti’, in which the individual notes are barely perceptible.

.... *N. allardi*, p. 34.

9. *Nemobius fasciatus* (De Geer). Map 6.
Gryllus fasciatus De Geer, 1773. Mem. Ins. **3**:522.
Nemobius vittatus. Walker, F., 1869. Cat. Derm. Salt. Brit. Mus. **1**:57, 114.
........Walker, F., 1872. Can. Ent. **4**:30.
Acheta vittata. Piers, 1894. Trans. N. S. Inst. Sci. **8**:410.
Nemobius fasciatus vittatus. Piers, 1896. Trans. N. S. Inst. Sci. **9**:210.
Nemobius fasciatus. Piers, 1918. Trans. N. S. Inst. Sci. **14**:330-335.
Nemobius fasciatus fasciatus. J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:265.
Common name — 'Striped Ground Cricket'.

Size relatively small, males 7.5 to 10 mm., females 8 to 11 mm. in length; head and pronotum hairy; ovipositor straight; tegmina of females cover about one-half of abdomen in micropterous forms, and about two-thirds of abdomen in males, cross veins prominent; macropterous females with wings and tegmina extending to tip of ovipositor, of males, correspondingly long; colour black to sooty brown, tegmina and legs somewhat paler; occiput with four distinct dark longitudinal stripes, ovipositor blackish.

N. fasciatus has been commonly called *N. f. socius* Scudder in the literature. This situation has been clarified recently by the separation of two good species, this being called *N. fasciatus* (De Geer), and the species formerly called *N. f. fasciatus* (De Geer) being called *N. allardi* Alexander and Thomas (1959).

This species is separable from the related *N. allardi* Alexander and Thomas, rather easily in the case of living specimens in the field and with considerably less ease, in the case of dried, pinned specimens. It has been found easier to determine species in the field by observation of stridulation (see key) than by collecting and basing determination upon morphological characters. Of the nearly 700 specimens of *N. fasciatus* and *N. allardi* presently housed in the collection of the Nova Scotia Agricultural College, eighty-one per cent are *N. fasciatus*, the remaining nineteen per cent are *N. allardi*. *N. fasciatus* is the most common and widespread field cricket in Nova Scotia, having been taken at forty-six localities in fourteen counties during the present study.

It is difficult to determine to which species previous records for Nova Scotia referred. Piers (1918) gives some indication, from his description of colour variation that both species were included. His description of longitudinal head stripes is typical of *N. fasciatus*, but his description of stridulation —"a trilling sound or tremolo–resembling the syllable *ple-e-e-e, ple-e-e-e, ple-e-e-e*" — is more typical of *N. allardi*. Rehn (1939a) mentions "both the intense black and the striking contrasted forms", so it is possible that he also had both species.

10. *Nemobius allardi* Alexander and Thomas. Map 7; Fig. 22.
Nemobius allardi Alexander, R. D. and E. S. Thomas, 1959. Ann. Ent. Soc. Amer. **52**(5):592.
Nemobius fasciatus. Piers, 1918. Trans. N. S. Inst. Sci. **24**:330-335.
Nemobius fasciatus fasciatus. J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:265.
Common name — "Allard's Ground Cricket".

Very similar to *N. fasciatus*; average lighter in colour; longitudinal stripes on occiput obscure to almost absent; distinguishable from *N. fasciatus* by features in key.

Fulton (1931) described the differences in stridulation in *fasciatus* (now *allardi*) and *socius* (now *fasciatus*). In 1933, Fulton reported on failure of the two to hybridize in the laboratory, and Fulton (1937) gave differences in morphology, colour, ecology and life history in North Carolina. He did not however, assign specific rank but considered them subspecies. Alexander and Thomas (1959), after examination of all existing types in the group, determined that *socius* is in fact *fasciatus* (De Geer) and assigned *allardi* as a new name for the species formerly called *fasciatus fasciatus*.

N. allardi, is not nearly as numerous as *N. fasciatus* in Nova Scotia, although it is widespread in distribution. It is recorded from Pugwash, Collingwood and Springhill, Cumberland County; Truro, Colchester County; Brule, Scotsburn and West River, Pictou County; Lochaber, Antigonish County; Creignish Mountain, Judique and Pleasant Bay, Inverness County; Sweet's Corner, Hants County; Kentville, South Berwick and Wolfville, Kings County; Melvern Square, Bridgetown, Le Quille and Graywood, Annapolis County;

South Ohio, Yarmouth County; and Sable River, Shelburne County.

11. *Nemobius carolinus* Scudder. Map 8; Fig. 24.
Nemobius carolinus Scudder, 1877. Proc. Bost. Soc. Nat. Hist. 19:36.
Nemobius carolinus. Piers, 1918. Trans. N. S. Inst. Sci. 14:335-336.
Common name — 'Carolina Ground Cricket'.

Resembles *N. fasciatus*, but is smaller; tegmina of male reach about the tip of the abdomen, of female cover about one-half of abdomen; hind wings wanting; ovipositor distinctly shorter than the hind femora and a little upcurved; teeth of ovipositor, very coarse on upper side, very fine and widely spaced on under side. Colour generally pale brown, head dark brown with yellow markings on vertex; antennae dark brown on three basal joints and on distal third, middle light brown; disc of pronotum mottled with light and dark brown spots, lateral lobes dark brown, sparsely clothed with coarse dark hairs; femora light brown with transverse darker markings on outer face; tibiae light brown and thickly clothed with fine dark hairs, bases of spines dark brown; tegmina yellowish. Body length, male 8.3 mm., female 8.5 mm.

Range is wide over eastern Canada and United States. Nova Scotia probably marks the northern limit. Its distribution extends south to Florida and Texas. It is found on grassy, sunny banks of streams, and about fences. Its trill is weak and continuous, indefinitely prolonged.

N. carolinus occurs rather widely in Nova Scotia, having been collected at Amherst, Collingwood and Pugwash, Cumberland County; Truro, Colchester County; Centreville and Wolfville, Kings County; South Ohio, Yarmouth County; Cookville, Lunenburg County; Dalhousie Mountain, Eden Lake, Pictou County; Cook's Cove, Guysborough County, and Creignish Mountain, Inverness County. Urquhart collected this species at Chester, Lunenburg County and at Sable River, Shelburne County in 1949 and Ferguson has taken it at Halifax and at Lake Rossignol, Queens County (Identified by the author at the Nova Scotia Museum of Science).

12. *Nemobius palustris* Blatchley. Map 8; Fig. 23.
Nemobius palustris Blatchley, 1900. Psyche 9:53.
Common name — 'Marsh Ground Cricket'.

Very small slender species, males shorter and broader than females; pronotal disc one-third broader than long, thickly covered with stiff, black bristles; occiput, and dorsal parts of the fore and middle femora also hairy; tegmina of male forming elongate quadrangle with sides feebly converging from base; tips narrowly rounded; tegmina of female covering slightly over one-half of the abdomen, tips broadly rounded; ovipositor distinctly but feebly upcurved, apex feebly enlarged, teeth of upper edge very fine and closely set. Colour generally uniform dark pisceous; maxillary palpi light except for apical joint. Body length, males 5.2-6.2 mm., females 6-6.8 mm.

This species is found in and around sphagnum mosses, peat bogs, tamarack swamps and cranberry bogs all along the Atlantic coast of the United States and the southwestern coast of Nova Scotia. Its call, according to Allard (1911) is a faint quavering, high-pitched trill. It was collected only at South Ohio, Yarmouth County, during the present study, and stridulation was not observed. Other collections are also from the Atlantic coastal area, two males, in the Nova Scotia Agricultural College collection, taken by Urquhart at Sable River, Shelburne County, August 8, 1949. Ferguson has found it on a bog on Prospect Road, Halifax County (Identified by the author at the Nova Scotia Museum of Science).

Suborder Caelifera
Superfamily Acridoidea
Family Tetrigidae

The Tetrigidae are characterized by the backward extending pronotum and by small size, averaging smaller than most other grasshoppers of Nova Scotia. Long and short-winged variants of the same species are common. Individual adults may be found nearly throughout the season. Adults usually hibernate and lay eggs during May and June. The nymphs usually mature by fall, but some nearly full grown nymphs may hibernate, as nymphs have been found early in April.

Four species, in two subfamilies, have been found in Nova Scotia.

Key to Nova Scotia Subfamilies of Tetrigidae.

1. Antennae with 22 segments; tegmina with subapical pale spot.
....................Batrachideinae, p. 37.

Antennae with 12-14 segments; tegmina without subapical pale spot.
.... Tetriginae, p. 38.

Subfamily Batrachideinae

Genus *Tettigidea* Scudder.
Tettigidea Scudder, 1862. Bost. J. Nat. Hist. **7**:476.

13. *Tettigidea lateralis* (Say). Map 9.
Acrydium laterale Say, 1824. Amer. Ent. **1**:10.
Tettigidea lateralis subspecies, Rehn and Grant, 1958. Trans. Amer. Ent. Soc. **85**:24-65.

Vertex very slightly produced beyond front margin of eyes; frontal costa rounding broadly into median carina of vertex, absent basally; pronotum convex between and in front of humeri; anterior margin of pronotum obtusely angled, not surpassing middle of eyes; median carina of pronotum distinct but not prominent, somewhat higher anteriorly; tegminal sinus more acute than lower sinus; surface of pronotum with fine raised pustules and distinct longitudinal rugae. Colour dark, variable. Length of body, males, 8.5 to 9.1 mm., females, 10.1 to 10.8 mm.

The first published report of this species from Nova Scotia was that of Rehn and Grant (1958), a single specimen from South Milford, July 10. This is in Annapolis County, although their distribution map indicates Milford, Colchester County.

Rehn and Grant (*loc. cit.*) studied a large series of *T. lateralis* and described a new subspecies, *Tettigidea lateralis cazieri*, with its typical range in the southwestern plains of the United States of America. Many northern specimens of *T. lateralis*, from Manitoba, Ontario, Quebec and Nova Scotia are classed as *T. lateralis lateralis* (Say), but intermediate, tending toward *T. lateralis cazieri*, and not typical of *T. lateralis lateralis*.

This species was found at Kingston, Kings County, during the present survey, in company with *Tetrix subulata*. It was not found elsewhere. These specimens, and a male from Hampstead, New Brunswick, appear to be very similar to a specimen from Hanover, New Hampshire, by comparison with the keys, descriptions and figures of Rehn and Grant (*loc. cit.*). They are thus probably not typical *T. lateralis lateralis*.

Subfamily Tetriginae

Key to Nova Scotia Genera of Tetriginae.

1. Antennae 12- or 13-segmented; median carina of pronotum high and crest-like, arched longitudinally; upper lateral sinus of pronotum about half as deep as lower sinus. .... *Nomotettix*, p. 38.

Antennae 14-segmented; median carina of pronotum low and rather flat from lateral view; upper lateral sinus of pronotum nearly as deep as lower sinus. .... *Tetrix*, p. 39.

Genus *Nemotettix* Morse.
Nomotettix Morse, 1894. Psyche **7**:150.

Rehn and Grant (1955) consider that *Nomotettix* is derived from *Tetrix*. North American species can be separated by the cristate pronotum but no single character will separate these two genera on a world-wide basis.

14. *Nomotettix cristatus cristatus* (Scudder). Map 10; Fig. 26.
Batrachidea cristata Scudder, 1862. Bost. J. Nat. Hist. **7**:478.
Nomotettix cristatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:23, 27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:254-257.
Nomotettix cristatus cristatus. J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.......J. W. H. Rehn, 1939a. Frag. faun. Mus. Zool. polon. **4**:260.
Common name — 'Crested Grouse Grasshopper'.

This is one of the smallest of Nova Scotian orthopterans; pronotum is high and arched; body finely granulate, especially on the pronotum; vertex projects beyond the eyes, front margin of pronotum extended over back of head; notches of lateral posterior pronotum as in key; pronotum reaching to apex of hind femora. Greyish-brown in colour, slightly lighter beneath; two blackish spots on the lateral areas of the pronotal disc. Length of body, male 7.5-9 mm., female 8-9.5 mm.

The native range of *N. cristatus* covers the eastern United States and southern Canada. It is rather widely distributed in Nova Scotia where it is common in dry pastures.

It has been collected at the following points: West Brook and Windham, Cumberland County; Truro and Sutherland's Lake, Colchester County; Mount Uniacke and Sweet's Corner, Hants County; Brule, Pictou County; Brierly Brook, Antigonish County; Kentville, North Alton, Centreville, Aylesford, Coldbrook, Gaspereaux and Kingston, Kings County; Pleasant Lake, Yarmouth County; Sable River, Shelburne County; Waverley, Prospect Road and Halifax watershed area, Halifax County; New Ross, Lunenburg County; Lake Kedgemakooge, Queens County; and Lincolnville, Guysborough County; Nova Scotia and from Allardville, New Brunswick. Rehn (1939a) reported two juveniles of this species from North Sydney, Cape Breton County, Nova Scotia. The earliest and latest recorded dates in Nova Scotia are April 15 and August 30. *N. cristatus* was collected at Wood Island, Prince Edward Island, by Urquhart in 1949, and was reported by Rehn and Grant (1955) from Hampton, York County, and Holcomb and McNamees, Northumberland County, New Brunswick.

Genus *Tetrix* Latreille.

Tetrix Latreille, (1802). Hist. Nat. Crust. Ins. **3**:284.

Only two species, *T. subulata* (Linn.), and *T. arenosa angusta* (Hanc.) have been found in Nova Scotia although *T. brunneri* (Bolivar) is found in northern and central New Brunswick. Rehn and Grant (1956) reported *T. brunneri* from Tabusintac, Fredericton and Bathurst, New Brunswick while the Canadian National Collection also has a specimen from Bathurst, New Brunswick. *T. ornata* Say was erroneously reported by Gooderham (1917), a misidentification of *T. arenosa angusta.*

Key to Nova Scotia Species of *Tetrix.*

Median carina of pronotum elevated more or less distinctly along entire length; dorsal part of pronotum high in middle, sloping on the sides; body very slender, especially males; front margin of vertex obtusely angulate viewed from above, median carina at most very slightly projecting; hind part of pronotum long, apex narrowly acute, surpassing hind femora in extended form and reaching the ends in abbreviated form.

..................*T. subulata*, p. 40.

Median carina of pronotum indistinct, slightly elevated on anterior third; dorsal area of pronotum flat or nearly flat; body robust; front margin of vertex very slightly rounded, the median carina projecting; apex of pronotum reaching considerably beyond hind femora in extended form and only slightly beyond in abbreviated form.

............*T. arenosa angusta*, p. 41.

15. *Tetrix subulata* (Linnaeus). Map 11; Fig. 25, 27.

Gryllus subulatus Linnaeus, 1761. Fauna Suecia, ed. **2**:236.

Acrydium granulatum Kirby, 1837. Faun. Bor. Am. Ins. **4**:251.

Acrydium granulatum. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:23, 27.

.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:257-259.

Acrydium subulatum. J. W. H. Rehn, 1939. Can. Ent. **71**:176.

.......J. W. H. Rehn, 1939a. Frag. faun. Mus. Zool. polon. **4**:261.

Tetrix subulata. Rehn and Grant, 1955. Proc. Acad. Nat. Sci. Phila. **107**:145-165.

Common name — 'Granulated' or 'Slender Grouse Grasshopper'.

Pronotum and legs finely granulated; easily recognized by the prominent angulate form of front margin of vertex. Colour variable, greyish to reddish-brown, sometimes blackish, often with median white band along full length of pronotum; inner wings often with bluish or bottle-green. Length of body, male 8.5 to 13.5 mm., female 11 to 15.3 mm.

T. subulata prefers sedgy meadow lands and swales on sandy soil which remains moist. The general range is northern North America, northern Europe, and northern Asia, north of 38 degrees Latitude.

T. subulata is a relatively common species in Nova Scotia, by far the most common of the Tetrigidae. It has been found at Springhill, Cumberland County; Truro, Debert and Sutherland's Lake, Colchester County; Millville and Mount Thom, Pictou County; Kennetcook, East Uniacke and Windsor, Hants County; many points in Kings County; Graywood, Annapolis County; Smith's Cove, Digby County; Yarmouth, Deerfield, Pleasant Lake and South Ohio, Yarmouth County; Cookville, Lunenburg County; Halifax, Port Wallis and Sackville, Halifax County; Glen Alpine, Antigonish County; Lincolnville, Guysborough County; and at Baddeck, Victoria County.

It is also reported from Fredericton, New Brunswick, (Canadian National Collection). Rehn and Grant (1955a) reported this species from Tabusintac, Holcomb, Fredericton, and St. Andrews, New Brunswick, as well as some of the previously mentioned localities in Nova Scotia. The earliest and latest recorded capture dates are April 5 and October 4.

Hebard (1935) concluded that this species, known as *granulatus* (Kirby), was the same as the palaearctic species *subulata* and that the name *subulata* (Linn.) should take precedence over *granulatus*. This opinion was accepted until Rehn (1952) stated that *granulatus* Kirby should stand as "the North American representative of the *subulata* species group" until further work could be done to clarify the situation. Rehn and Grant (1955a), after studying specimens from a wide range of the Holarctic region concluded that Hebard was correct in placing Kirby's *granulatus* in synonymy with *subulata* of Linnaeus.

16. *Tetrix arenosa angusta* (Hancock). Map. 12; Fig. 28.
    Tettix angustus Hancock, 1896. Trans. Amer. Ent. Soc. **23**:238.
    ?*Tettix ornata* Harris. F. Walker, 1871. Cat. Derm. Salt. Brit. Mus. **5**:813.
    Acrydium ornatum. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:23, 27. (*nec* Say).
    Acrydium arenosum angustum. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:35.
    ....Piers, 1918. Trans. N. S. Inst. Sci. **14**:259-263.
    Tetrix arenosa angusta. Rehn and Grant, 1956. Trans. Amer. Ent. Soc. **82**:129-139.

Description as in key to species; pronotum narrow in front, nearly twice as broad at shoulders; lateral carinae close together anteriorly, becoming obsolete, reappearing twice as wide apart, diverging to shoulders, and converging to apex. Generally light brown in colour, somewhat darker on pronotal disc; basal part of hind wings irridescent, veins dusky. Length of body to end of pronotum, male 8.9 mm., female 10 mm.

T. arenosa angusta is found near banks of streams and boggy places. The subspecies *angusta* occurs throughout the Alleghanian Division of the Transition Zone, an Austral type as opposed to the Boreal distribution of other *Tetrix* species. This species has been found over the western part of the province. Specimens to hand were collected at Debert and Truro, Colchester County. Truro marks part of the northern limit of the species, according to Rehn and Grant (1956a). Gooderham (1917) reported it also from Kings, Hants, Annapolis, and Yarmouth Counties but gave no localities. The earliest and latest capture dates are April 23 and August 20.

F. Walker (1871), as reported by Piers (1918), identified "*Tettix ornata* Harris" from the Redman collections of 1821. This single specimen is said to be correctly identified. The species has not been taken since and Piers has somewhat doubtfully referred the record to *T. arenosa angusta.* It is more likely that the identification should stand, but that the locality (stated merely as 'Nova Scotia') is not accurate. Rehn and Grant (1956b) have pointed out that none of the *T. ornata* (Say) subspecies have been found in Eastern Quebec or the Maritime provinces although they occur in wide distribution over the remainder of southern Canada and the United States. The nearest approach to this region is *T. ornata hancocki* (Morse) from Fort Kent, Maine and Lac Ste. Marie, Quebec.

Family Acrididae[3]

The Acrididae are characterized by having long, stout, hind femora; tibiae armed with numerous spines; tarsi three-segmented; head hypognathous, with face often oblique. This family contains the best known and the most destructive species of Orthoptera.

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[3] Sometimes referred to by North American authors as Locustidae, following Comstock, a name which is not internationally recognized and which is in any case confusing because of its former erroneous application to the Tettigoniidae.

Key to Nova Scotia Subfamilies of Acrididae.

1. Prominent conical tubercle borne on the prosternum between the prothoracic legs.
. . . . Cyrtacanthacridinae[4], p. 43.

No tubercle borne on the prosternum between the prothoracic legs.
. . . . 2.

2. Face usually very oblique; median carina of pronotum never high and crest-like, or cut by more than one sulcus.
. . . . Acridinae, p. 53.

Face nearly or quite vertical; median carina of pronotum usually cut by more than one sulcus.
. . . . Oedipodinae, p. 60.

Subfamily Crytacanthacridinae

Included in this subfamily are some of the most injurious species of Orthoptera. Winter is passed in the egg stage in Nova Scotia species; nymphs hatch early in summer, and adults are present from July to the end of October. Stridulation does not occur in this group as represented in Nova Scotia.

Key to Nova Scotia Genera of Cyrtacanthacridinae.

Tegmina absent; space between mesosternal lobes distinctly broader than long, as broad or nearly as broad as the lobes; prosternal spine short and conical.
. . . . *Zubovskya*, p. 43.

Tegmina present; usually well developed, sometimes short, but never absent; space between mesosternal lobes generally longer than broad.
. . . . *Melanoplus*, p. 45.

Genus *Zubovskya* Dovnar-Zapolskij.
Zubovskya Dovnar-Zapolskij, 1933. Trav. Inst. Zool. Acad. Sci. U.R.S.S. 1-253-258.

This genus is one of a group into which the old genus *Podisma* of Latreille (1829) has been divided. All Canadian species which were previously known under *Podisma* fall into the genus *Zubovskya*.

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[4] Cantatopinae of European authors.

17. *Zubovskya glacialis glacialis* (Scudder).
Pezotettix glacialis Scudder, 1863. Bost. Jour. Nat. Hist. **7**:630.
Podisma glacialis. Piers, 1918. Trans. N. S. Inst. Sci. **14**:286-288. [Hypothetical—not reported].
Zubovskya glacialis glacialis. Urquhart (*in litt.*), 1955.
Common name — 'Wingless Mountain Grasshopper'.

Wingless, medium to small species; prozona nearly twice as long as metazona, pronotum smooth, lateral carinae usually wanting, median carina evident, but low, cut by three transverse sulci in male, by hind one only in female; sulci deep on lateral lobes, front one short; prosternal spine short, stout, with bluntly rounded tip; interspace between mesosternal lobes of males as wide as the lobes, of females nearly twice as long; abdomen of female compressed, carinate, of male subcylindrical, upcurved; vertex between the eyes as broad in male, or twice as broad in female as first antennal joint; face distinctly but not strongly oblique; male supra-anal plate long, triangular, acute at tip, sides sinuous, median sulcus deep; furculae of male slender, subparallel; cerci stout, erect, feebly tapering above broad basal third, tips oblique; upper margin of subgenital plate broadly rounded, truncate, but with slight median notch, tubercle below upper margin broad, prominent. Colour dark, greenish above, greenish-yellow beneath, sparsely clothed with erect hairs; head greenish-yellow, often with dark streak on face; mouthparts pale; pronotum dark green, shining black stripe from eye to abdomen, faint on metazona and abdomen; inner and lower faces of hind femora coral red; hind tibiae bluish-green, spines black at tips, cerci black. Body length, male 15-17.5 mm., female 19-28 mm.

Piers (1918) included *Z. glacialis* as probably occurring in Nova Scotia but not reported. It was taken in Nova Scotia, possibly at Sable River, Shelburne County, by Dr. C. E. Atwood (Urquhart, *in litt.*, 1955) but the specimens appear to have been misplaced at the Royal Ontario Museum of Zoology and Palaeontology. The species frequents patches of alders and wire birch in heavily wooded areas. It is mainly subalpine E. M. Walker (1915) reported *Z. glacialis* from Dundee, Prince Edward Island.

In Ontario and Manitoba the race *Z glacialis canadensis* is found, but typical *Z. g. glacialis* is recorded from Quebec, Prince Edward Island, the New England States, New York and Pennsylvania. Presumably specimens from Nova Scotia would also be *Z. g. glacialis.* No specimen was found during the present study, for it was unfortunately not possible to make collections in the localities where the species is most likely to be found. It was not found, after thorough search, in the area surrounding Sable River, Shelburne County.

Genus *Melanoplus* Stål.

Melanoplus Stål, 1873. Recens. Orth. 1:79.

Key to Nova Scotia Species of *Melanoplus.*

1. Males ....2.
Females ....7.

2. Tegmina fully developed, reaching or surpassing apex of abdomen....................................3.

Tegmina short, not reaching apex of abdomen. ....6.

3. Cerci either equal in breadth or tapering beyond the middle, tip slender or acuminate, never forked. ....4.

Cerci with apex expanded, broader beyond the middle, tip spatulate, or forked. ....5.

4. Apex of subgenital plate elevated, with small but distinct median notch; cerci short, nearly equally broad throughout, not longer than twice middle breadth. ....*M. bilituratus*, p. 48.

Apex of subgenital plate not notched; cerci at least three times as long as middle breadth, apical half tapering. ....*M. femur-rubrum*, p. 49.

5. Size large (more than 25 mm.); cerci with apical half much enlarged, but not forked; pronotum with light-coloured lateral stripes along margin of disc and continued along tegmina. ....*M. bivittatus*, p. 52.

Size smaller (less than 20 mm.); cerci distinctly forked, forks nearly equidistant. ....*M. keeleri luridus*, p. 53.

6. Cerci elongate, slightly expanded at base, middle little narrower than base, apex expanded; furculae small, triangular, well separated.
.................*M. fasciatus*, p. 47.

Cerci less elongate, apical half narrower but more than half as broad as extreme base; furculae about half as long as supra-anal plate, fused along inner base.
.................*M. borealis*, p. 50.

7. Size large, robust, hind femora 15 mm. or more long; two distinct lateral yellow stripes on head, pronotum and tegmina.
....................*M. bivittatus*, p. 52.

Size smaller, hind femora not over 15 mm., yellow stripes, as above, lacking.................................8.

8. Dovetailing interspace between mesosternal lobes longitudinal or quadrate; tegmina usually passing hind femora, prozona not swollen. ....9.

Dovetailing interspace between mesosternal lobes subquadrate or distinctly transverse; tegmina not longer than hind femora; prozona swollen. ....10.

9. Prosternal tubercle nearly cyclindrical; tip bluntly rounded; cerci one and one-half to twice as long as greatest width, sharply pointed, somewhat acuminate, the converging sides slightly concave.
............*M. femur-rubrum*, p. 49.

Prosternal tubercle tapering, tip pointed; cerci short, only about one and one-third times as long as greatest width, rather blunt at tips, converging sides straight or convex.
.................*M. bilituratus*, p. 48.

10. Tegmina about reaching ends of hind femora.
............*M. keeleri luridus*, p. 53.

Tegmina shorter, covering only one-half to two-thirds of the abdomen (some long-winged variants are exceptions).
....11.

11. Dull greyish brown above, clay yellow below.
..................*M. fasciatus*, p. 47.

Dull greenish yellow, tinged with fuscous.
....................*M. borealis*, p. 50.

Females of *M. fasciatus* and *M. borealis* are difficult to separate with any degree of certainty. It is notable that *M. fasciatus* females found in Nova Scotia are consistently and distinctly darker above than those of *M. borealis*.

18. *Melanoplus fasciatus* (F. Walker). Map 13; Fig. 38.
Caloptenus fasciatus F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:680.
Melanoplus fasciatus. Piers, 1918. Trans. N. S. Inst. Sci. **14**:296-297. [Hypothetical—not reported].
Melanoplus fasciatus. J. W. H. Rehn, 1939. Can. Ent. **71**: 177.
Common name — 'Huckleberry Grasshopper'.

Size small, sexes nearly equal; robust; occiput elevated about pronotum; interocular space as broad in male, nearly twice as broad in female, as basal joint of antennae; frontal costa as broad as interocular space, feebly sulcate below ocellus in male, and slightly concave around it in female; pronotum expands feebly on metazona, disc rounded on prozona, flat on metazona, hind margin broadly rounded or obtuse-angled; median carina distinct only on metazona, faint on parts of prozona; tegmina usually covering two-thirds of abdomen in female, or three-quarters in male; male cerci straight, four times as long as broad, middle third slightly narrowed, apical third concave with tip rounded and incurved; supra-anal plate broad, triangular, apex subacute, margins elevated, median ridges extending from base three-quarters of distance to apex, uniting with a cross carina at apical third; furcula minute, widely separated, lying outside the median ridges; subgenital plate longer than broad, apical margin rounded, feebly elevated at middle. Colour dull greyish-brown or reddish-brown above, clay yellow below; male darker than female; females much darker above than females of *M. borealis*; black band behind eye extending to metazona, bordered below by greenish-yellow; tegmina dull red-brown; hind femora dull yellowish-brown with two broad blackish bars; hind tibiae red to pale green, lighter ring near base, spines black. Body length, male, 17-19.5 mm., female, 20-23 mm.

This species ranges from northern Labrador to New Jersey and west nearly across the continent. It is primarily boreal, having its southern limit at 40 degrees north latitude. It is found in dry, open woods on sandy or rocky soil.

Piers (1918) did not record this species; it was first reported in Nova Scotia by J. W. H. Rehn (1939) by a single female taken by Bayard Long in Yarmouth County on "bog barrens back of Goose Lake, Lower Argyle, August 11, 1920". Urquhart collected *M. fasciatus* at Bridgetown, Annapolis County, Grand Lake, Halifax County and North East Margaree, Inverness County in 1949. In 1953 a single male was found together with *M. keeleri luridus* and a few *M. femur-rubrum* on October 27, while hunting deer at West Brook, Cumberland County. The character of the environment of the area is very different from the Argyle barrens, as it is on rather high ground, near the edge of a heavily forested area. The presence of blueberry (*Vaccinium* spp.), and other ericaceous plants is the only feature common to both sites.

Subsequent collections revealed that *M. fasciatus* is common in blueberry fields around West Brook, New Canaan, Farmington, Windham and Ward's Brook, Cumberland County, and at Pleasant Lake, Lower Argyle and Lower West Pubnico, Yarmouth County. On Cape Breton Island it was found at Creignish Mountain, North East Margaree and Pleasant Bay, Inverness County, and Black Brook Cove, Victoria County. Specimens from apparently small and scattered colonies have been found at Dalhousie Mountain, Pictou County; Grand Lake and Cow Bay, Halifax County; Melvern Square and Bridgetown, Annapolis County; Lake Kedgemakoogee, Queens County; and Sable River, Shelburne County. E. M. Walker (1915) reported this species from Dundee and Bothwell, Prince Edward Island, as well as from the Magdalen Islands. Hebard (1915) and Rehn (1939; 1939a) both supplied records from Newfoundland. As indicated by capture records, adults may be found between August 9 and October 27.

19 *Melanoplus bilituratus bilituratus* (Walker). Map 14; Fig. 31, 33, 35.
Caloptenus bilituratus F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. 4:679.
Melanoplus mexicanus auctt. (*nec* Saussure).
Melanoplus atlanis. Scudder, 1894. Ann. Rpt. Ent. Soc. Ont. 26:64.
.......Piers, 1896. Trans. N. S. Inst. Sci. 9:215.
.......Gooderham, 1917. Proc. Ent. Soc. N. S. 1916:26, 27.

.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:290-296.

Melanoplus mexicanus. J. W. H. Rehn, 1939. Can. Ent. **71**:177.

Melanoplus mexicanus mexicanus J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:263.

Common name — 'Lesser Migratory Grasshopper'.

Prosternal spine tapering, tip pointed; tegmina much longer than abdomen (one-quarter or more beyond the tip); apex of subgenital plate of male with small distinct median notch; male cerci short and nearly equally broad throughout, rounded at ends, length less than or equal to twice middle breadth. Colour similar to *M. femur-rubrum*, variable, upper parts dark greyish-brown; under surface of abdomen yellowish; face light green; mouthparts light; blackish band from behind eye to lateral part of prozona; tegmina greyish-brown, distinctly sprinkled with fuscous along median area; hind femora dirty yellowish-brown, or slightly reddish-yellow, with two oblique blackish bars across the upper and outer faces; hind tibiae dull burnt red. Body length, male, 17-21 mm., female, 16-27 mm.

The range of this species is very wide, from the Canadian to the upper part of the Lower Austral Zone, approximately the same as for *M. femur-rubrum.* It is one of the commonest species in Nova Scotia where it is the most important agricultural pest of all the Orthoptera. It is widely reported from New Brunswick, Prince Edward Island, and the Magdalen Islands as well as from all parts of Nova Scotia. It has been recorded as adult from June 30 to October 28.

M. bilituratus appeared on Sable Island in 1891 and during the next four years became extremely abundant there. In 1896, it suddenly disappeared and from then until 1918, no grasshoppers were reported from the island (Piers, (1918)). Since that date no records are available and the present status of insect populations there is unknown.

20. *Melanoplus femur-rubrum femur-rubrum* (De Geer). Map 15; Fig. 30, 32, 37.

Acrydium femur-rubrum De Geer, 1773. Mem. Hist. Nat. Ins. **3**:498.

Caloptenus femur-rubrum. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:678.

.......F. Walker, 1872. Can. Ent. **4**:30.
Melanoplus femur-rubrum. Piers, 1896. Trans. N. S. Inst. Sci. **9**:215.
.......Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:24-27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:297-301.
.......J. W. H. Rehn, 1939. Can. Ent. **71**:177.
Melanoplus femur-rubrum femur-rubrum J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:263.
Common name — 'Red-legged Grasshopper'.

Prosternal spine nearly cyclindrical, tip bluntly rounded; tegmina somewhat longer than abdomen; apex of male subgenital plate not notched; male cerci at least three times as long as middle breadth; apical half less than half as broad as its extreme base (broad and tapering). Colour variable; usually brownish above; greenish grey on front and sides of head and thorax, sides and underparts; dirty white or greyish yellow line on side of thorax from insertion of tegmina to insertion of hind leg; broad black bar from behind eye extends on lateral part of pronotum; tegmina brown, usually spotted with fuscous along basal and median area; hind femora brown with two fuscous bars on upper edge, lower edge yellowish with pale red on outer part, joint black; hind tibiae bright red with black spines. Body length, male 16-23 mm., female 18-28 mm.

The range of the subspecies is very wide, from the Canadian to the upper part of the Lower Austral Zone. It is very common all over Nova Scotia where it is most numerous on dykes and dry meadows.

It was also reported from Moncton, New Brunswick, and Bunbury and Malpeque, Prince Edward Island, by E. M. Walker (1915), and the Nova Scotia Agricultural College insect collection has specimens from Wood Island, Prince Edward Island. In Nova Scotia, adults have been recorded from July 3 to October 28. This species and *M. bilituratus* are found in the adult stage over a longer period than all other Orthoptera in Nova Scotia with the exception of the Tetrigidae.

21. *Melanoplus borealis borealis* (Fieber). Map 16; Fig. 34.
Caloptenus borealis Fieber, 1853. Lotos **3**:120.

Melanoplus extremus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:24, 27.

Melanoplus extremus junius. Piers, 1918. Trans. N. S. Inst. Sci. **14**:301-302.

Common name — 'Northern Grasshopper'.

The short-winged form has tegmina not reaching the tips of the hind femora, generally about 11 mm. long and reaching to the tip of the abdomen in males and covering one-half to three-quarters in the female; bluntly subacuminate at apex. In the long-winged form the tegmina surpass the tips of the hind femora, and are generally considerably longer (up to 17 mm. long), rather broadly rounded at apex. In short-winged form, the wings are much shorter than the tegmina; in the long-winged form the wings are very little shorter.

Apex of male subgenital plate without a median notch; male cerci short and broad, apical half distinctly more than half as broad as extreme base, gently curved, well rounded at tip; furculae parallel, cylindrical, tapering, about half as long as supra-anal plate. Colour dark greenish-yellow; black bar behind eye extending on prozona; pronotum olive brown above, greenish yellow on sides; tegmina olive-brown, sometimes with a few dark spots on median area; hind femora yellowish, tinged with red-brown, lower face light orange; hind tibiae reddish or yellowish with black spines. Body length, male, 16-20 mm., female, 20-24 mm.

The range includes much of Canada and the northern part of the United States. It is a boreal species confined to the Hudsonian, Canadian and Transition Zones.

The species is common in certain localities in Nova Scotia; Rodney, West Brook, New Canaan, Windham, Farmington, Westchester Station, Westchester Mountain and Ward's Brook, Cumberland County; Truro, Colchester County; Dalhousie Mountain and Brule, Pictou County; Kentville, Centreville, Aylesford Lake and Woodville, Kings County; Bridgetown, Annapolis County; Goodwood, Halifax County; Crescent Beach, Lunenburg County; Lower Argyle and Kemptville, Yarmouth County; and River Ryan, Cape Breton County. The earliest recorded date is July 3. The latest recorded date is August 11, but there is little doubt that adults persist until somewhat later in the season.

M. b. borealis was reported by E. M. Walker (1915), as *M. b. junius* Dodge, from Hillsboro, New Brunswick, Souris and Southport, Prince Edward Island, and from the Magdalen Islands. J. W. H. Rehn (1939) reports it from Port-aux-Basques, Newfoundland as *M. borealis* (Fisher). The same author (1939a) records it (also as *M. borealis*) from Grande Miquelon and St. Pierre. The Nova Scotia Agricultural College insect collection has specimens from MacDonald's Corner, Queens County, New Brunswick.

22. *Melanoplus bivittatus* (Say). Map 17; Fig. 29, 39.
Gryllus bivittatus Say, 1825. J. Acad. Nat. Sci. Phila. **4**:308.
Caloptenus bivittatus. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:678.
.......F. Walker, 1872. Can. Ent. **4**:30.
Melanoplus femoratus (Burm.). Piers, 1896. Trans. N. S. Inst. Sci. **9**:218.
Melanoplus bivittatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:24, 27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:303-307.
.......J. W. H. Rehn, 1939. Can. Ent. **71**:177.
.......J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — 'Two-striped Grasshopper'.

Largest of genus in Nova Scotia; tegmina reaching or slightly passing hind femora, sometimes slightly shorter in female; cerci of male large, wide, with apical half expanded but not forked, somewhat boot-shaped with wide toe and distinct but small heel; furculae short, swollen, triangular. Colour above, bright apple-green, underparts yellowish; distinct yellow line extends from upper part of eye along lateral angle of pronotum, and along anal vein of tegmen to its extremity; bordered below by a wider black band on head and pronotum, widest on prozona; diagonal yellow line extends from insertion of tegmen to insertion of hind leg; hind femora greenish-black on upper half of outer face to darker at tibial segment; outer face margined with yellow; hind tibiae poppy-red, dusky at base, spines black. Body length, male, 26.5-28 mm., female 31-35 mm. (Some up to 40 mm.).

The red-legged form of *M. bivittatus* is common all over Nova Scotia and has been reported from July 2 to October 27.

Occasionally, it causes crop damage, particularly to hay, pasture and grain on dyked lands. E. M. Walker (1915) reported it as common in Prince Edward Island and also from Moncton, New Brunswick. Hebard (1915) recorded it as *M. femoratus* (Burm.) from Newfoundland.

23. *Melanoplus keeleri luridus* (Dodge). Map 18; Fig. 36.
Caloptenus luridus Dodge, 1876. Can. Ent. **8**:11.
Melanoplus luridus. Piers, 1918. Trans. N. S. Inst. Sci. **14**:307. [Footnote: possibility of occurrence only.]

Rather small in size, head not prominent; tegmina reaching or slightly surpassing tips of hind femora, narrow and gently tapering; prosternal spine short, conical, blunt and erect; male cerci distinctly forked, branches nearly equally distant; furculae minute triangular lobes. Colour generally brownish-fuscous and rusty brown; fuscous post-ocular band narrow and confined to prozona; hind femora with outer face yellowish-brown, dorsal area blackish-fuscous broken by three yellowish spots which suffuse the whole inner face; lower face bright orange; hind tibiae coral red with narrow fuscous basal annulus, tibial spines black on apical half. Body length, male 19 mm., female, 27 mm.

M. keeleri keeleri (Thomas) occurs in the south eastern part of the United States. The range of *M. keeleri luridus* (Dodge) covers the northeastern part of the United States and north into Alberta, Manitoba and Ontario. Since it is present in Nova Scotia it undoubtedly occurs in New Brunswick although it has not been reported thence. The collection of this species during the present study constitutes the first record for Nova Scotia. Piers (1918) indicated the possibility that this species might be found in this province. A series of 18 specimens was collected at West Brook, Cumberland County; 3 males and 3 females, October 27, 1953; 5 males and 7 females, September 7, 1954. The only other capture location is only five miles distant, at New Canaan, where the species is not common.

Subfamily Acridinae

The face in the Acridinae is usually decidedly oblique, meeting the vertex in an acute angle; lateral foveolae are well developed.

In Nova Scotia four species in three genera are known, and a fifth species may occur.

Key to Nova Scotia Genera of Acridinae.

1. Lateral foveolae of vertex small and not visible from above.
.... *Orphulella*, p. 54.

Lateral foveolae of vertex plainly visible from above as linear depressions between the eyes and the apex.
.... 2.

2. Median carina of pronotum low, cut somewhat behind the middle by the principal sulcus.
.... *Chorthippus* p. 56.

Median carina of pronotum rather high and sharp, cut somewhat in front of the middle by the principal sulcus.
.... *Stethophyma*, p. 57.

Genus *Orphulella* Giglio-Tos.
Orphylella Giglio-Tos, 1894. Boll. Mus. Zool. Anat. Comp. Torino **9**:10.

Key to Nova Scotia Species of *Orphulella*.

Pronotum generally with lateral carinae little incurved, about equally separated in front and behind; vertex blunt, central depression extending close to apex; prozona usually slightly longer than metazona; dorsal valve of aedeagus, in lateral view, more or less constricted at apex, almost pointed.
.... *O. speciosa*, p. 54.

Pronotum generally with lateral carinae strongly incurved, more widely separated behind than in front; vertex rectangular to slightly acute, the central depression removed from apex one-third in male, to one-fourth in female, of width of apex; prozona and metazona nearly equal in length or metazona slightly longer; dorsal valve of aedeagus, in lateral view, more or less enlarged or knobbed at apex.
.... (*O. pelidna*), p. 56.

24. *Orphulella speciosa* (Scudder). Map 19; Fig. 40, 42.
Stenobothrus speciosus Scudder, 1862. Bost. J. Nat. Hist. **7**:458.

Orphulella speciosa (Scud.). Scudder, 1899. Can. Ent. 31:184. ["Halifax, N. S., Piers".]
.......Piers, 1918. Trans. N. S. Inst. Sci. 14:264-266. [Refuted record of Scudder, above.]
.......Urquhart, *in litt.*, 1951.
Common name — 'Pasture Grasshopper'.

Face very oblique, vertex bluntly rounded, obtuse in female, right-angled in male; lateral foveolae not visible from above; pronotum as in key; tegmina usually reaching ends of hind femora, but varying from 3 mm. shorter to 3 mm. longer in females, and 1.5 mm. shorter to 2 mm. longer in males. Colour variable, four distinct variations occurring; (a) head, disc of pronotum and tegmina green, (b) head and disc of pronotum green, tegmina rose-red, (c) head and pronotum brown; tegmina rose-red; (d) head, pronotum, and tegmina brown; the green variant is the only one recorded from Nova Scotia; dark line behind eye reaching pronotum along whitish lateral carina; tegmina with a few spots which are sometimes wanting; hind femora greenish or brownish, not banded; hind tibiae dull brown to yellow without a pale ring at the base. Length of body, male 13-14 mm., female 16-21 mm.

O. speciosa ranges over eastern and central North America. It is very numerous in New England, but scarce in Nova Scotia.

It prefers dry, sandy, or loamy soils, and grassy untilled fields, and is most active during hot weather. It is non-migratory and moves chiefly by leaping.

O. speciosa was reported from Nova Scotia by Scudder (1899) from a collection by Piers, but the record was later rejected by Piers (1918) as being in error. Urquhart (1949) holds the belief that the error was made in determination, and that the species in question was actually *O. pelidna.* However, *O. speciosa* has been taken in Nova Scotia by Urquhart, at Bridgetown, Annapolis County, August 14, 1949. the first definite record. A female specimen taken at Norton, New Brunswick, September 9, 1949, another from Welsford, New Brunswick, August 31, 1949, and a damaged specimen from Antigonish, Nova Scotia, August 7, 1949, are located in the Nova Scotia Agricultural College insect collection.

25. *Orphulella pelidna* (Burmeister). Map 19.
Gomphocerus pelidnus. Burmeister, 1838. Handb. Ent. **2**:650.
Orphulella pelidna. Urquhart, 1949. (Unpublished).

This species has not been recorded from Nova Scotia, but Urquhart (1949) believes that it almost certainly is present. As noted under *O. speciosa*, he is of the opinion that Scudder's (1899) record refers to *O. pelidna.* There is no previous record of any attempt to search out this species in its normal habitat in localities where it might be found. It was not found during the present study.

Genus *Chorthippus* Fieber.
Chorthippus Fieber in Kelch, 1852. Grundl. Orthop. Obserschles.; 1.

26. *Chorthippus longicornis* (Latreille). Map 20; Fig. 41.
Acrydium longicorne Latreille, 1804. Hist. Nat. Crust. Ins. **12**:159.
Stenobothrus curtipennis (Harris). F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:754.
.......F. Walker, 1872. Can. Ent. **4**:31.
.......Piers, 1896. Trans. N. S. Inst. Sci. **9**:213.
Chorthippus curtipennis. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:25, 27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:266. 269.
Chorthippus longicornis. J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.......J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:261.
Common name — 'Short-winged Brown Grasshopper'.

The name *Acridium longicorne* of Latreille is a *nomen dubium* and may refer to either of the European species *Chorthippus parallelus* (Zetterstedt, 1821) or to *Ch. montanus* (Charpentier, 1825). It is considered doubtful that any of the European names should apply to North American species (Vickery, unpublished).

Foveolae of vertex plainly visible from above as linear depressions; median carina of pronotum not high or sharp, cut behind the middle, lateral carinae incurved; tegmina of male usually reaching end of abdomen, of female usually covering two-thirds of abdomen, but longer or shorter in either sex; wings slightly shorter than tegmina; hind femora rather slender. Colour variable, green, olive-grey, brownish to reddish; lateral carinae of pronotum whitish, each with a dark line crossing diagonally from behind the eye and forming a dark margin outside of the anterior three-fifths and inside of the posterior two-fifths. Body length, male 15 mm., female 18.5 mm.

This insect frequents thick grasses in damp places, dry meadows and roadsides. It is not considered to be economically important.

The distribution of this species in Nova Scotia is very general, as it has been found in all but two counties and in these two counties very few collections have been made. It is common all over the northern United States and Canada in the Canadian and Transition Zones. The full distribution of the species, as presently defined, is Holarctic.

Genus *Stethophyma* Fischer.
Stethophyma Fischer, 1853. Eur. :297.

Brooks (1958) has followed Dirsh (1956) in removing this genus from the Acridinae and placing it with the oedipodines. The change was based upon the type of tegminal venation and the stridulatory apparatus found in males. Dr. D. K. McE. Kevan, of the Entomology Department, Macdonald College of McGill University (personal communication, 1959), for the present agrees in principle with Jacobs (1953) and Dirsh (1956) in giving separate tribal status to three groups (Acridini, Oedipodini, and Truxalini) within the subfamily Acridinae, placing *Stethophyma* in the tribe Oedipodini. Rehn and Grant (1960) rejected Dirsh's classification, following a survey of stridulatory apparatus and tegminal venation, as well as genitalia, in over 140 genera. They recognize a single subfamily, Acridinae, to include both the Oedipodinae and Acridinae of former authors, as well as the Truxalinae (sensu Dirsh). Apparently no category between genus and subfamily is recognized.

With this in mind, the genus *Stethophyma* is retained in the subfamily Acridinae.

Key to Nova Scotia Species of *Stethophyma.*

Scapular area of tegmina with a pale yellow streak; intercalary veins of male tegmina with very obscure, low teeth; lateral carinae of pronotum cut by all three sulci before the middle.

..................*S. lineatum*, p. 58.

Scapular area of tegmina without a pale yellow streak; intercalary veins of male tegmina with minute, sharp, elevated teeth; lateral carinae of pronotum cut only by first and third sulci.

......................*S. gracile*, p. 59.

27. *Stethophyma lineatum* (Scudder). Map 21; Fig. 43.
Arcyptera lineata Scudder, 1862. Bost. J. Nat. Hist. **7**-462.
Mecostethus lineatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:25-27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:269-271.
Stethophyma lineatum. J. W. H. Rehn, 1939. Can. Ent. **71**:176.
Common name — 'Striped Sedge Grasshopper'.

Foveolae of vertex very shallow but visible from above; pronotum with three distinct carinae; median carina rather high and sharp, plainly cut somewhat in front of the middle by principal sulcus; lateral carinae distinctly divergent behind; wings and tegmina well developed, surpassing ends of femora by about one-third the length of the tibia. Colour generally brownish to purplish-brown with yellow markings; head and pronotum brown, pronotal disc lighter, underparts green; abdomen dark brown on top and sides, light green beneath; pale yellow line from eye across pronotum to join yellow line on tegmina; hind femora olive on outer face, blackish near apex, with three white spots midway, upper edge brownish, lower edge maroon with two black marks separated by yellow near apex; hind tibia buff, darker near base and apex. Body length, male 26 mm., female 36 mm.

The range is wide, Canadian, Transition, and northern part of Upper Austral Zones, in the northern United States and southern Canada, east of the prairie, east of longitude 100 degrees, and north of latitude 40 degrees. It frequents wet meadows from late July to near the end of October.

It is found in western Nova Scotia but it is rather rare in the rest of the province.

It is recorded from Aylesford and Wolfville, Kings County; Bridgetown and Graywood, Annapolis County; Tiddville, Digby County; Deerfield, Gavelton, Quinan and South Ohio, Yarmouth County; Sable River, Shelburne County; Frank Lake, Lunenburg County; and Grand Lake, Goodwood, and Lawrencetown, Halifax County. The earliest and latest recorded capture dates are August 8 and October 26. It is also reported to be widespread in Prince Edward Island and has been recorded from the Magdalen Islands by E. M. Walker (1915). Hebard (1915) and Rehn (1939, 1939a) also reported this species from Newfoundland.

28. *Stethophyma gracile* (Scudder). Map 21; Fig. 44.
Acryptera gracilis Scudder, 1862. Can. Nat. and Geol. **7**:463.
Mecostethus gracilis. Piers, 1896. Trans. N. S. Inst. Sci. **9**:215.
Mecostethus gracilis. Gooderham, 1917. Proc. Ent. Soc. **1916**:25, 27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:271-272.
Common name — 'Graceful Sedge Grasshopper'.

This handsome species resembles *S. lineatum*, but the intercalary vein of the tegmina of male has sharp, elevated minute, closely set teeth. It is more robust and squat than *S. lineatum*. The pale yellow line of the tegmina is absent. The lower edge of the hind femora is a striking bright red. Body length, male 19-23 mm., female 26.5-31 mm.

The range is about the same as for *S. lineatum* but slightly more northern. It is chiefly confined to the Canadian and Transition Zones. *S. gracile* appears to have about the same distribution as *S. lineatum* in Nova Scotia, being quite common in the western counties from early August to late September. It has been collected at Kentville, Black Hole, Grafton and Kingston, Kings County; Bridgetown, Annapolis County; Truro and Sutherland's Lake, Colchester County; Halifax and Cow Bay, Halifax County; and from Creignish Mountain, Inverness County. Gooderham (1917) also reported *S. gracile* from Yarmouth County but gave no locality for the record.

E. M. Walker (1915) reported this species from Dundee, Prince Edward Island, and the Canadian National Collection has two specimens from St. John, New Brunswick.

Subfamily Oedipodinae[5]

The members of this subfamily are characterized by the nearly vertical face; pronotum short with median carina often raised as a crest and cut by one or more transverse sulci; prosternum not bearing a spine or tubercle; wings are frequently brightly coloured. The general colour is usually dull brown, green or grayish. Winter is usually passed in the egg stage. Males often stridulate while in flight.

Key to Nova Scotia Genera of Oedipodinae.

1. Median carina of pronotum notched by only one sulcus. ....2.

Median carina of pronotum notched by two sulci, the front notch often less distinct than the hind one; hind wings with two or three radial veins greatly enlarged, yellow with a dark median transverse band widening behind. ....*Circotettix*, p. 64.

2. Disc of hind wing nearly transparent, but not distinctly bordered black. ....3.

Disc of hind wing opaque, black with yellow border lateral carinae of pronotum extending only to principal sulcus; disc with few or no tubercles. ....*Dissosteira*, p. 63.

3. Disc of pronotum roof-shaped, front margin angulate; hind wings transparent with a dark bar along middle of anterior margin, yellow at base, remaining two-thirds smoky, paler at apex. ....*Chortophaga*, p. 61.

Disc of pronotum flat, front margin truncate; median carina low, faintly notched by principal sulcus; hind wings

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[5] No longer recognized by Rehn and Grant (1960), who include this group in the subfamily Acridinae.

transparent with dusky veins.
........................*Camnula*, p. 62.

Genus *Chorthphaga* Saussure.
Chortophaga Saussure, 1884. Mém. Soc. Phys. Nat. Genève **28** (9):72.

29. *Chortophaga viridifasciata* (De Geer). Map 22.
Acrydium viridifasciata De Geer, 1773. Mem. Hist. Nat. Ins. **3**:498.
Common name — 'Northern Green-striped Grasshopper'.

Medium sized species, body slim; vertex horizontal and triangular, apex truncate; foveolae very shallow, elongate triangular; frontal costa prominent; segments of antennae short and slightly flattened; disc of pronotum roof-shaped, anterior margin angulate and projected forward, hind margin acute-angled; median carina not prominent, straight and faintly notched on anterior half; lateral carinae visible only on metazona; tegmina long and narrow, longer than abdomen, with apical half membraneous.

Colour dimorphic, either brown or green; green form with head, pronotum, basal part of tegmina and outer face of hind femora grass-green, with apical part of tegmina and narrow costal stripe pale brown, and abdomen reddish-brown; brown form with apical halves of tegmina darker; hind tibiae brown with white ring near the base. Body length, males 17-24 mm., females 24-30 mm.

This species is here recorded in Nova Scotia for the first time. It frequents sunny slopes in dry, grassy places. It is widely distributed over North America east of the Rocky Mountains, south to Georgia, Oklahama and Texas, and north to Nova Scotia, New England and Ontario. Blatchley (1920) stated that both colour phases occur together in Indiana with green females and brown males predominant. Less than twenty per cent of the females were brown and much less than twenty per cent of the males were green. The series taken during the present study includes four green females, three brown females and four brown males: 2 females, West Brook, Cumberland County, June 23, 1951; same location, 2 males, 2 females, June 20, 1952; 2 males, 1 female, Rodney, Cumberland County, June 21, 1952; and 2 females, West Brook, June

29, 1953. Urquhart collected this species at Southampton, Cumberland County in 1949. The Canadian National Collection has a specimen of *C. viridifasciata* which was taken by T. N. Freeman, June 27, 1938, at Waweig, Charlotte County, New Brunswick. This is the nearest previous record to Nova Scotia.

Genus *Camnula* Stål.
Camnula Stål, 1873. Recens. Orth. **1**:114.

30. *Camnula pellucida* (Scudder). Map 22.
Oedipoda pellucida Scudder, 1862. Bost. J. Nat. Hist. **7**:472.
Camnula pellucida. Piers, 1896. Trans. N. S. Inst. Sci. **9**:214.
.......Gooderham, 1917. Proc. Ent. Soc. **1916**: 26-27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:274-277.
.......J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.......J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — 'Clear-winged Grasshopper' or 'Roadside Grasshopper'.

Small species; head compressed; pronotum with disc flat and smooth, much wider behind, truncate in front, median carina low, of equal height throughout, faintly cut by one sulcus in front of the middle; sides of the pronotum deeper than long; tegmina narrow, reaching beyond abdomen. Colour generally light brown; dark triangular spot behind eye and dark vertical spot on front half of lateral lobe of pronotum; tegmina smoky brown, light and dark patches on the sides, darker on dorsal surface with a yellowish stripe along humeral angle; wings transparent with dark veins; hind femora yellowish brown, darker at apices, and faintly marked with dark bars; tibiae yellowish-brown; abdomen yellowish beneath, sides darker. Body length, males, 17 to 21 mm., females, 19.5 to 28.5 mm.

The range of *C. pellucida* includes the southern part of the Canadian Zone, the Transition, and upper part of the Upper Austral Zones. It is common throughout southern Canada and northern and western United States. It is found in dry locations, particularly in fence rows and by roadsides. This species is often very injurious to vegetation.

C. pellucida is widely distributed all over Nova Scotia and has caused damage to agricultural crops. It occupies third position after *Melanoplus bilituratus bilituratus* (F. Walker) and *M. femur-rubrum* (DeGeer) in destructiveness. It has been found in the adult stage from July 14 to October 2.

E. M. Walker (1915) reported this species from both Prince Edward Island and Newfoundland. It is also known from Richibucto, New Brunswick (Canadian National Collection) and specimens are on hand from MacDonald Corner, Queens County, New Brunswick.

Genus *Dissosteira* Scudder.
Dissosteira Scudder, 1876. Ann. Rpt. U.S. Chief Eng. 1876, App. JJ:511.

31. *Dissosteira carolina* (Linnaeus). Map 23; Fig. 45.
Gryllus (*Locusta*) *carolina* Linnaeus, 1758. Syst. Nat. ed. **X**:433.
Dissosteira carolina. Piers, 1896. Trans. N. S. Inst. Sci. **9**:214.
.......Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:26-27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:278-281.
.......J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.......J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — ‘Carolina Grasshopper’.

Disc. of pronotum with front margin nearly truncate and hind margin obtuse-angled; median carina high, cut before the middle by a deep narrow notch, front lobe almost straight, hind one arched; lateral carinae rounded and extending about one-third their length beyond the abdomen. The colour is variable, chocolate-brown, brown-black, to grey, underside lighter; tegmina brown, clouded, and spotted with darker brown; hind wings dark brown or black with a pale yellow outer border, the apex smoky with several darker spots; hind femora with inner face light, crossed by three blackish bands, the first nearly covering the basal half; hind tibiae dirty-yellowish. Body length, males 26 to 30 mm., females 34 to 40 mm.

D. carolina ranges throughout the Transition and Upper and Lower Austral Zones, as well as the southern part of the Canadian Zone. It is found from coast to coast in Canada and the United States. It frequents dry, sandy areas such as dusty roads.

D. carolina is rather common all over the mainland of Nova Scotia. No collections have been made on Cape Breton Island but I have observed this species at Pleasant Bay, Inverness County, and at Baddeck Victoria County. The earliest and latest capture dates are July 24 and October 28.

Genus *Circotettix* Scudder.
Circotettix Scudder, 1876. Bull. U. S. Geol. Geogr. Surv. Terr. **2**:264.

32. *Circotettix verruculatus* (Kirby). Map 24.
Locusta verruculata Kirby, 1873. Fauna Boreale Amer. **4**:250.
Oedipoda rugosa. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:731. (*nec* Scudder).
.......F. Walker, 1872. Can. Ent. **4**:31.
Oedipoda sulphurea. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:729-730. (*nec* Fabricius)
.......F. Walker, 1872. Can. Ent. **4**:31.
Circotettix verruculatus. Piers, 1896. Trans. N. S. Inst. Sci. **9**:214.
Circotettix verruculatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:26-27.
.......Piers, 1918. Trans. N. S. Inst. Sci. **14**:281-285.
.......J. W. H. Rehn, 1939. Can. Ent. **71**:177.
.......J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — 'Snapper' or Eastern Crackler'.

Pronotum flattened on top, right angled to acute angled behind; median carina elevated in front and notched by two sulci before the middle, the front notch usually less distinct; wings and tegmina about as long as total body length; hind wings with three enlarged radial veins. The colour is variable, usually blackish above, with underparts brown; tegmina greyish to brownish-grey, blotched with black; hind wings semi-transparent, pale yellow on basal half, followed by a blackish band, then by a semi-clear area with blackish veins; some radial veins deep yellow at bases, costal margin dusky; hind femora greyish with four blackish bands; eyes black or black spotted with grey. Body length, males 24 to 25 mm., females 25 to 28 mm.

Its range is very wide and more northern than *D. carolina.* It is found in the Canadian and Transition Zones, and in elevated parts of the Upper Austral Zone. It prefers dry sandy areas.

C. verruculatus is common in Nova Scotia and has been reported from nearly all areas. The earliest and latest dates recorded are July 18 to October 18. It has also been reported from Moncton, New Brunswick by E. M. Walker (1915) and from Port-aux-Basques, Newfoundland by J. W. H. Rehn (1939).

ACKNOWLEDGEMENTS

This paper is based upon a thesis submitted to the Faculty of Graduate Studies and Research, McGill University as partial requirement for the degree of Master of Science. I should like to express thanks to the Nova Scotia Department of Agriculture and Marketing, and in particular Messrs. C. M. Collins and M. E. Neary, for making this study possible; to Dr. E. M. Du Porte, Department of Entomology, Macdonald College, for his interest and encouragement; to Dr. F. A. Urquhart, Royal Ontario Museum of Zoology and Palaeontology, who provided specimens and information on Nova Scotia species; and to Mr. D. C. Ferguson, Nova Scotia Museum of Science, for permitting me to examine their specimens. I also should like to thank the following, who checked the manuscript, in whole or in part: Dr. D. K. McE. Kevan, Department of Entomology, Macdonald College, who was particularly helpful; Dr. F. A. Urquhart and Dr. E. M. Walker, Royal Ontario Museum of Zoology and Palaeontology; Dr. R. S. Bigelow, Department of Entomology, Macdonald College, and Dr. R. D. Alexander, Museum of Zoology, University of Michigan, for advice on Ensifera; Dr. A. B. Gurney, United States Museum, Washington, District of Columbia, for advice on *Melanoplus* species; and Mr. J. A. G. Rehn, Academy of Natural Sciences of Philadelphia, for advice on various matters.

Finally, I wish to express my appreciation to my wife, Muriel J. Vickery, for the great assistance in typing and retyping, and without whose encouragement, the study would not have been carried out.

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96th ANNUAL MEETING
PRESIDENTIAL ADDRESS

J. G. Aldous

October 20, 1958

In the Presidential Address last year, some time was devoted to interesting aspects of early Nova Scotian science as recorded in the Proceedings of this Institute. In a great many cases, observations taken from this past history have found value in solving the problems which face us in the present, and, no doubt will continue to do so in the future. This will be true only if the problems we deal with continue to be purely scientific, and by "scientific" I mean seeking by experiment, the answers to questions concerning natural phenomena.

No one will dispute the fact that this is the field of science, but not all will agree that the scientist should devote himself exclusively to this field of activity. For upon the scientist of today, the scientist of tomorrow depends for growth and maturation. If the recording of ideas is important to the nourishment of scientists, then the communication of these ideas to young people is vital to the species if it is to flourish. It is perhaps not enough to observe and record, one should also explain and teach,—in short—educate.

Those of us who earn our livelihood by working in some branch of science would probably agree that one of the greatest contemporary problems facing the Western nations has to do with the education of young scientists. In a somewhat complacent fashion we have tacitly believed that scientists beget scientists and therefore, whatever else happens, the species is bound to increase in number. While this is no doubt true insofar as actual numbers of trained personnel is concerned, it focusses the attention on the quantitative aspect of the problem. Quality is the characteristic which has escaped attention.

No serious agriculturist who is interested in supplying eggs on a large scale production basis, can any longer afford to believe in the old saying "eggs is eggs", because the public knows very well that there are good eggs and bad eggs, large eggs and small eggs. The agriculturist solves his problem by careful selection and nutrition. His attention is focussed on quality for he has learned that quantity ceases to be the problem once the qualitative aspect has been established.

It seems to me that we have developed our Western educational program along the lines of a belief that "brains is brains" and that although we do not hold with the thesis that all men are born equal, we facetiously evade the issue by redefining the statement: "Although all men are born equal, some are more equal than others". Until we are capable of initiating a program of human development such as that pictured by Aldous Huxley in "Brave New World" we must face up to the fallacies and problems implicit in these statements. We must turn our attention to the quality of the product we, as scientists, are interested in, namely, young scientists. And perhaps this is something which this Institute might consider as a part of its scientific activity in the near future. A step in this direction was taken last year when Council decided to offer prizes for the best scientific essays submitted by students during the academic year.

But by merely encouraging young persons in University to continue their science training we do not solve the problem. There is a very much larger population of young people, perhaps not yet in University who must be convinced of the desirability of a career in science, most especially from the point of view of the prestige accorded the scientist by the community in which he lives. This is indeed a far-reaching problem, the solution to which leads us into the field of economics. It is unfortunately true that in our North American civilization, the sign of success in life is the dollar sign. Distasteful as it may seem, we must realize that science would appear an attractive career to many more young people than it does were the financial rewards greater. To argue otherwise, to insist upon the quality of dedication, is to bury one's head in the sands of idealism; for this attitude overlooks the fact that lack of financial reward turns many capable young people away from a career in science. Continued insistence on the quality of dedication can only result in either of two outcomes: greatly reduced numbers of graduate students, or graduate classes filled with students too stupid to do anything else.

Our consideration of the financial aspects of our problem goes deeper, for, were we allowed to make an attractive financial offer to the scientist-in-training, we will soon find that eventually the money to pay him must come from the taxpayer's pocket. Thus not only must we "sell" the career in science to the potential scientist, but we must "sell" the general public and government institutions the idea that science, and that which accrues from being a scientist is a worthwhile commodity in which to invest. Herein lies one of our greatest difficulties.

In the last analysis, it is John Q. Public who must be convinced, because although government agencies may continue to dispense monies for research and training, they are, in theory, sensitive to public opinion, And as long as they remain sensitive to public opinion, they are not likely to lay out large sums of the tax-payer's money unless there is public pressure brought upon them to do so.

Just how sensitive government agencies are to public opinion, is difficult to decide, but it is fairly certain that they are not particularly prone to listen to the pleas of the individual. Last year your President wrote the chief officer of a large Canadian government agency pointing out that there was no enticement to continue post-graduate work in the fact that a fresh B.Sc. employed as a technician could earn as much as $300 per month, but directly he registered for a course leading to a higher degree, his salary would drop to $87.50 per month during the academic term and $200 a month during the summer. A plea was made for at least considering that this differential was too great. The reply received was, if nothing else, succinct: "I am afraid that our basic outlooks are so far apart that it would not be possible for us even to get into communication in anything as short as a letter".

If this is the attitude of federal government toward higher education (and I am not sure that it is) then there is still a good deal of wisdom attached to the action of the Fathers of Confederation when, 90 years ago, they placed education in the hands of the provincial governments!

Are these attitudes likely to change and if so, what or who is likely to change them? To answer the second question first, for it is easier, public opinion is the only force likely to be able to bring enough pressure to bear upon government so that public monies can be directed toward education. But having answered this question, a much larger one,—and one implicit in the first one asked above—now presents itself, namely, what force is likely to change public opinion?

A recent editorial appeared in Science (4 July 1958) entitled "To help improve quality" and in it the author reports on certain education bills which were to come before the U.S. federal government. The House Committee on Education and Labor is expected to bring out a new bill emphasizing the need for improving the quality of American education. The bill will likely call for funds for "counseling and guidance programs, employment of counselors to help inexperienced teachers of science, mathematics and (perhaps) foreign languages, purchase of laboratory equipment, research in teaching methods scholarships and student loans . . ."

Now, bills of this nature have had wide support from education leaders and scientific institutions, but in order to provide some guarantee of their passage through the House of Representatives and the Senate, priority has been given, in the bills, to science and engineering students. Were this not so, the editorial points out, there would be small chance of them passing in the House for the simple reason that they could not be justified on the grounds of being vital to civil defence. This means that public opinion toward education (and in this case, one branch of education) is likely to change only when it becomes a political necessity to do so. It is indeed unfortunate that fear on an international basis, rather than pride on a national basis is the agency most likely to alter the public's opinion concerning quality of education.

This Institute alone can do nothing to bring about changes in public opinion, but it might, together with other scientific institutions accomplish more on a national basis. Meanwhile the Institute should consider ways and means of nourishing the small population of young scientists we already have. I firmly believe, however, that our attention should not be focussed solely at the University level. If it is our interest to conserve as many scientific brains as possible, we must do something about the loss which occurs, because of financial considerations, between High School and University. This action might well take the form of a scholarship given to a student with a scientific turn of mind who would not be able, for financial reasons, to enter University. Admittedly this is a small effort, but it is an effort in the right direction and this, together with whatever is done for the young scientist once he is in University, constitutes an activity just as valuable to science as the reporting of scientific papers. In closing I should like to express my thanks to the members of Council who carried on the affairs of the Institute during the past year. It was a pleasure to have been associated with them, and in their hands, under the new President, I feel sure that the Institute may look forward to profitable years ahead.

PROCEEDINGS OF MEETINGS

Session of 1958-59

Meetings were held in the Medical Sciences Building, Dalhousie University, the Arts Building, Dalhousie University, and the Biological Laboratory, Acadia University.

97th Annual Business Meeting, October 20, 1958.

Twelve members were present. In the absence of the President, Dr. J. G. Aldous, the meeting was presided over by the First Vice-President Dr. J. R. Dingle who read the address prepared by Dr. Aldous. The address appears on page 71 of the Proceedings. The Officers presented their reports.

The Treasurer's Report.

Owing to the death of the Treasurer, Dr. A. N. O'Neill, the Treasurer's Report was presented by Dr. J. R. Dingle who reported:

Receipts	$3,125.17
Expenditures	3,688.60
Invested Funds	1,000.00
Bank Balance, October, 1958	1,452.67

The Corresponding Secretary, P. L. Hoogland, reported:

During the past year, the business of this office has been as usual. It consisted of: mailing out one issue of our Proceedings (Vol. 24, part 2) to all members and the addresses on the exchange mailing list, keeping up-to-date this mailing list, carrying out correspondence regarding exchanges, mailing out of separate issues of the Proceedings upon request and so forth. The most sought after publications are still those of the momograph type, such as, The Flora of Nova Scotia, the Grasses of Nova Scotia, the Lepidoptera of Nova Scotia. Of these, the Flora, printed in 1945, is now practically out of stock. It will be necessary to decide soon whether or not it is going to be reprinted or perhaps whether the author should be asked to prepare a second edition.

I should like to mention here that I have always done the work of this office with great pleasure, and if necessary, I shall continue doing it. However, it seems that the time has come to make a slight change in our administrative set-up. It appears to me that the business of the library and of the exchanges could be handled much more effectively by one person rather than by two. I should like to suggest therefore that consideration be given to fusing the offices of librarian and corresponding secretary and that the officer in charge of the combined office be appointed rather than elected and that this appointed officer be the person actually responsible for this Institute's Library holdings.

The Librarian, Miss E. M. Campbell, reported:

The most significant event in the year since the last annual report, has been the establishment of a bindery by a Halifax firm—Skerry and Leonard. A skilled binder from one of the Scandinavian countries does the work. The binding program will be continued this year and it is hoped that over seventy-five of the journals of the various societies can be bound. In addition, following the policy of the last few years, several new sets not previously bound, will be added to the list. Possibly the Societe Botanique de Paris, the American Midland Naturalist and the Elisha Mitchell Scientific Society.

The work of checking and correcting the entries of all the storage material is continuing and six Kardex files have been put in the library. Entries by title of all the Institute's holdings will be made. When this is completed a list will be sent to all the members of the Institute. Special double cards have been designed, on which are entered, not only the entries from the old cards, but the history of the society itself and its publications. This involves a great deal of checking in the various Union Lists.

Six double rows of steel shelving have been added to the space in the Attic, to try to relieve the congestion of an ever expanding collection. Each year there are additional exchanges and the need for more space is an ever-present problem.

The collection has been used to a greater extent in the last few years because of the listing of the Institute's holdings in the "Union List of Scientific Serials in Canadian Libraries" and in "New Serial Titles" of the Library of Congress. Frequent interlibrary loans are made to other provinces.

While the number of free exchanges coming to the library continues to expand, each year one or two societies give up the free exchange and request a subscription. The Research Foundation has carried on these subscriptions.

Officers elected for the year 1958-59 *were*:

President	Dr. J. R. Dingle
First Vice-President	Dr. W. J. Archibald
Second Vice-President	Dr. J. A. McCarter
Treasurer	Dr. C. R. Masson
Corresponding Secretary	Dr. P. L. Hoogland
Recording Secretary	Mr. H. S. Heaps
Editor	Dr. L. B. Macpherson
Librarian	Miss E. M. Campbell
Council	Mr. H. L. Cameron Dr. J. H. Greenblatt Dr. W. W. Hawkins Dr. G. F. O. Langstroth Dr. A. D. MacDonald
Auditors	Dr. H. L. Bronson Dr. H. D. Smith

New Members:

During the year the following new members were proposed and were elected by Council, Ordinary: J. E. Stewart, C. L. Gauvreau, A. J. Tingley, A. H. Houston, P. N. Srivastava, H. Soltan, Dr. Aterman, M. L. Pearce, W. Josenhans, G. B. Weld, W. A. Cochrane, T. J. Painter, J. Berrigan, A. B. Macullum, M. E. Delany, W. N. Watt, B. Larsen, Kathleen J. Blenkhorn.

Student Members: W. D. Watt, Veronika Ruf, Frances L. Goring, N. P. Patterson.

1*st Ordinary Meeting*, November 10, 1958.

Papers: 1. "The Source and Properties of the Enterolipomicron", by C. B. Weld; 2. "Slide-Rule for Converting Percentages to Mole Fractions", by C. R. Masson; 3. "The Kramer Phenomenon", by J. G. Kaplan, M. Kramer, and M. R. Pollock.

Extraordinary Meeting, November 17, 1958.

Dr. Eugene Hayden, Plant Pathologist of the Rust Prevention Association of Minneapolis, addressed the Institute on "The Relation Between Research in Agriculture and World Food Production".

2nd Ordinary Meeting, December 8, 1958.

Papers: 1. "Collagen of Cod Skin", by E. G. Young and J. W. Lorimer; 2. "A High Intensity Ultrasonic Generator", by J. D. Macpherson; 3. "Microbial Oxidation of Hydrocarbons", by J. E. Stewart.

3rd Ordinary Meeting, January 12, 1959.

Papers: 1. "α - Tocopherol Phosphate as a Blood Anticoagulant and Antilipaemic Agent", by W. W. Hawkins and S. Mookerjea; 2. "Corrosion of Magnesium Alloys Containing Iron and Nickel", by J. H. Greenblatt; 3. "The Varrentrapp Reaction", by R. G. Ackman.

4th Ordinary Meeting, February 9, 1959.

Papers: 1. "Microwave Breakdown in Air at High Altitudes", by A. D. MacDonald; 2. "Changes Occurring in the Fungal Floras of Slime Accumulations in Pulp and Paper Mills", by D. Brewer; 3. "Efficiency of Certain Simple Electrical Filter Circuits", by P. G. Kennedy.

5th Ordinary Meeting, March 9, 1959.

Papers: 1. "Degradative Studies on λ -Carrageenin", by K. Morgan; 2. "Some Aspects of Wood Chemistry," by T. J. Painter.

6th Ordinary Meeting, April 6, 1959.

Joint Meeting with the Valley Chapter. It was held at 7.30 p.m. in the Biological Laboratory of Acadia University.

Papers: 1. "Spectrofluorimetric Analysis of Skin in Vivo", by J. A. McCarter; 2. "Adaptability Studies with Flue Cured Tobacco", by D. C. MacKay; 3. "Pleistocene Geology of the Bridgewater Sheet, N. S.", by R. H. MacNeill.

7th Ordinary Meeting, May 11, 1959.

The prize for the Student Essay Contest was presented to Mr. D. M. Maxwell.

Papers: 1. "Microwave Breakdown in Xenon and Krypton", by G. F. O. Langstroth and A. D. MacDonald; 2. "Interaction Between Kinetin and Indole Acetic Acid in Bud Reactivation in Splachnum Ampullaceum", by K. E. von Maltzahn.

PROCEEDINGS OF MEETINGS (VALLEY CHAPTER)

Session of 1958-59

The Valley Chapter held seven meetings.

1*st Meeting*, November 10, 1958.

Paper: "The Origin of the Turtle Chrysemys in Nova Scotia", by S. Bleakney.

2*nd Meeting*, December 1, 1958.

Paper: "Considerations for Predicting Deciduous Tree Fruit Production", by T. H. Anstey.

3*rd Meeting*, January 13, 1959.

Papers: 1. "Vortex Rings in Liquids", by R. H. Magarvey and F. K. Chin; 2. "Studies on Depleted Blueberry Land", by I. V. Hall; 3. "Biology of the Predator *Anthocoris Musculus* (say) (Hermiptera: Anthocoridae) and the Influence of Hosts on its Distribution and Abundance", by H. T. Stultz.

4*th Meeting*, February 2, 1959.

Papers: 1. "Tidal Cycle Photography in the Tiverton Area", by H. Cameron; 2. "Recent Developments in Poultry Breeding and Testing", by F. Proudfoot.

5*th Meeting*, March 2, 1959.

Papers: 1. "Black Knot on Stone Fruits in Nova Scotia", by C. O. Gowley; 2. "Low Energy Colorimeter", by G. Tillotson.

6*th Meeting*, April 6, 1959.

Joint meeting with Parent Society.

7*th Meeting*, May 4, 1959.

Papers: "Mercury Residues on Apple Fruits and Foliage", by R. G. Ross and D. K. R. Stewart; 2. "Oil Possibilities of the Continental Shelf of Nova Scotia", by H. Cameron; 3. "Calyx End Rot of Apples", by J. F. Hockey.

ABSTRACTS

(Papers read before the Institute but not published in the Proceedings.)

THE SOURCE AND PROPERTIES OF THE ENTEROLIPOMICRON. C. B. WELD, Dalhousie University. (Read November 10, 1958). These minute particles that appear in the secretions of the small intestine have been shown to be different from chylomicrons which they resemble in appearance. They have a considerably lower lipid content and they are produced when the intestine is stimulated to activity and bear no relation to the chylomicron concentration in the blood.

The intestinal particles are separated from debris by centrifuging. The debris contains desquamated cells in varying states of degeneration and a considerable amount of mucous. The yield of the enterolipomicron particle does not parallel the yield of debris; at times there may be considerable debris and little particles fraction, whereas at other times there may be a considerable enterolipomicron yield with very little debris. Neither appear in quantity unless the loop is stimulated. The particles show a considerable sucrase activity and alkaline phosphatase activity, but negligible cytochrome oxidase and succinic dehydrogenase. On the other hand the debris shows a very slight sucrase and alkaline phosphatase activity but a definite cytochrome oxidase and succinic dehydrogenase content. Both fractions show catalase and proteinase activity. Microscope slide smears of the particles stained with methyl green and thyronin suggest a high concentration within the particle of ribonucleic acid.

Sections of the mucous membrane taken before and after stimulation are now under study. Preliminary indications show that the number of goblet cells in the mucosa is reduced after a period of activity. Special staining for cytoplasmic granules and electron microspic studies of the particles are now in progress. It is suggested that the particles are of the nature of secretory granules, secreted by the intestinal mucosa, and that they are cytoplasmic in origin.

SLIDE-RULE FOR CONVERTING PERCENTAGES TO MOLE FRACTIONS, BY C. R. MASSON, Maritime Regional Laboratory. (Read November 10, 1958). A slide-rule is described for converting percentages by weight to mole fractions in multi-component systems. The slide-rule has been designed so that it may be constructed from any existing slide-rule which has an L scale and an inverted D scale on the body, a separate slide being required for each system of interest. Suitable scales are given for the components of basic open-hearth slags.

THE KRAMER PHENOMENON: THE ACTION OF A CELL-FREE EXTRACT ON THE BIOSYNTHESIS OF PENICILLINASE IN THE ABSENCE OF SPECIFIC INDUCER. BY J. G. KAPLAN and M. R. POLLOCK, Dalhousie University. (Read November 8, 1958). When traces of penicillin are added to the growth medium of cells of B. cereus, strain 569, the culture responds by producing enormous quantities of the enzyme penicillinase whose function is the hydrolytic degradation of penicillin (Pollock). If penicillin is omitted from the medium, the basal level of this enzyme is so low as to be practically indectable. On the other hand, cells of B. cereus 569$\underline{\text{H}}$, a so-called constitutive mutant, produce maximal levels of this enzyme in absence of penicillin; addition of this substance has no effect whatever on penicillinase biosynthesis. Kramer showed that it was possible to extract from the constitutive mutant 569$\underline{\text{H}}$ a substance, or substances, which could, under certain conditions, cause the cells of 569 to produce penicillinase in the absence of the usual inducer, penicillin: this is the

Kramer phenomenon. Our experiments bear on the question of the chemical nature of the active material in the extract and on the nature of the phenomenon itself. Considerable indirect evidence, from the action of crystalline ribonuclease and the effect of purine analogues, suggest that the active principle is a specific ribonucleic acid; evidence from the incorporation of radioisotopes into the enzyme formed during treatment with the extract suggests that the phenomenon itself is a protein synthesis, and not reactivation of enzyme present in the extract, although many more data on this last question are necessary to establish total synthesis of the molecule of enzyme.

COLLAGEN OF COD SKIN. By E. G. YOUNG and J. W. LORIMER, Maritime Regional Laboratory. (Read December 8, 1958). Cod skin has been found to contain 75% collagen, 10% other protein, 2.5% peptides and amino acids, 0.5% mucopolysaccharide, 0.5% lipid, and 12% ash. After repeated extraction with mild aqueous solvents of pH 3.5-8.7 at 3 - 80°C, about 95% passed into solution. The collagen has been extracted with 0.1 M solutions of various hydroxy acids and their sodium salts at pH 3.6. It was recovered as microscopic needle-like fibrills, about 30 x 1 μ, with characteristic banding. It contained 18.2% N, 0.1% hexosamine, and a distribution of amino acids identical with the collagen of cod swim bladder. The content of hydroxyproline was 8.0%. Minimum solubility occurred at pH 5.0 - 5.2. The optical rotation changed and the mutarotation was partially reversible with time and temperature. The value for $S_{20}w$ was 3.17 ± 0.10 S, measured at 6 - 9°C, and for (η) 12.9 dl. g^{-1} at 1.4°C. From these values a particle weight of 330,000 was calculated and dimensions of 13 Å diameter and 3,000 Å length for an elongated rod of some flexibility. An irreversible decomposition into two components occurred sharply at 13 °± 0.5°.

A HIGH INTENSITY GENERATOR. By J. D. MACPHERSON, Naval Research Establishment. (Read December 8, 1958). During the course of the construction of a H St.Clair high intensity ultrasonic generator at Imperial College, considerable difficulty was met with the condenser pickup system. It was suggested that some type of simpler self maintaining oscillatory system could be used and the method described in this paper was the result of this investigation.

MICROBIAL OXIDATION OF HYDROCARBONS. By J. E. STEWART, Fisheries Experimental Station. (Read December 8, 1958). Biological oxidation of hydrocarbons has interested microbiologist for over seventy-five years. Despite this long standing interest, definitive information on this process is scarce, and the explanations of microbial hydrocarbon oxidation are inadequate today as they were during the earliest studies.

The study with which this discussion is involved was carried out at the State University of Iowa, Iowa City, Iowa. A series of enrichment cultures was set up using aliphatic paraffins as the sole carbon source. Two bacterial isolates from these cultures were selected for intensive study. One strain, when grown in the presence of decane, dodecane, tetradecane, hexadecene-1, hexadecane, hexadecanol-1, 1, 2-hexadecanediol, and octadecane, produced non-volatile esters.

The structure of some of these esters, their production, their significance and a speculative mechanism deduced from features of this work will be presented and discussed.

α-TOCOPHEROL PHOSPHATE AS A BLOOD ANTICOAGULANT AND ANTILIPAEMIC AGENT. By W. W. HAWKINS and S. MOOKERJEA, Maritime Regional Laboratory. (Read January 12, 1959). α-Tocopherol phosphate showed an anticoagulant effect on the blood of dogs and rabbits when given intravenously at a dosage level of 70 to 100 mg. per Kg. of body weight. The effect was of short duration. The dosage level was toxic and sometimes lethal to rabbits.

Rabbits were made hyperlipaemic by feeding them a diet of chow with added fat and cholesterol. If 100 mg. of α-tocopherol phosphate per Kg. of body weight were given one-half hour before, or if doses of 50 mg. per Kg. were given 24 hr., 17 hr., and one-half hr. before a blood sample was taken for analysis, it was found that the level of free cholesterol in the serum was lowered, and there was increased electrophoretic mobility and apparent breakdown of the β-lipoprotein. No other lipid fraction of the serum was affected.

For 20 days adult rats were fed a diet containing about 27% fat, including 0.5% cholesterol. During the last 5 days some were given twice daily intraperitoneal injections of 0.25 to 1 mg. of α-tocopherol phosphate per 100 g. of body weight, and on the 21st day, one-half hr. after another dose, blood was taken for analysis. None of the serum lipid fractions differed from those of control animals.

CORROSION OF MAGNESIUM ALLOYS CONTAINING IRON AND NICKEL. By J. H. GREENBLATT, Naval Research Establishment. (Read January 12, 1959). Magnesium alloys containing iron and nickel showed high rates of self corrosion but when these alloys were used as soluble plugs in steel structures the corrosion rate decreased markedly. Investigation of this anomaly showed that it was due to the formation of a passivating oxide film over the magnesium alloy surface. For such films to form, a certain critical anode current density must be exceeded and the electrolyte should not contain any film disrupting components. The critical anode current density for the alloys investigated appeared to be of the order of 55 ma/cm^2.

THE VARRENTRAPP REACTION. By R. G. ACKMAN, Fisheries Experimental Station. (Read January 12, 1959). This reaction, the conversion of oleic acid into palmitic acid by simple fusion with potassium hydroxide, was first noted in 1840. Since then several mechanisms have been proposed. It is now possible to demonstrate that this reaction takes place by a reversible prototropic reaction involving stepwise movement of the double bond, eventually to conjugation with the carboxyl group. This is the structure actually undergoing scission of the chain. Similar reactions take place on the alkali fusion of other types of unsaturated long-chain fatty acids.

MICROWAVE BREAKDOWN IN AIR AT HIGH ALTITUDES. By A. D. MACDONALD, Dalhousie University. (Read February 9, 1959). The problem of microwave breakdown near antennas of high flying craft is considered with a view to finding optimum transmission conditions. The fundamental processes of electrical breakdown in gases are described briefly. On the basis of available data in atmospheric composition, breakdown electric fields are computed for various frequencies between 100 mc/sec and 35 kmc/sec. Pulse transmission is considered and it is shown that more power may be transmitted at the higher frequencies. Values of power which may be transmitted for various pulse lengths and frequencies are calculated.

Changes Occurring in the Fungal Floras of Slime Accumulations in Pulp and Paper Mills. By D. Brewer, Maritime Regional Laboratory. (Read February 9, 1959). The accumulation of slime in pulp and paper mills is a matter of no little importance and has been the subject of numerous investigations as to the causes and the methods of control. These slimes are composed of fibres, debris, fungi, and bacteria in various proportions and vary greatly in appearance and consistency. Reports of the organisms isolated from such slimes indicate the presence of a large number of fungal and bacterial species. The predominance of either bacteria or fungi and the species present vary from mill to mill and from location to location in the same mill. This report shows that the species of fungi present in a slime at a given location can vary from sampling to sampling. In many instances the changes observed were associated with a change either in the temperature at the point of accumulation or in the fungicide used in the mill. However, sometimes under apparently the same conditions with little or no alteration in temperature, changes in the fungal floras have been observed to occur.

Efficiency of Certain Simple Electrical Filter Circuits, By P. G. Kennedy, Nova Scotia Technical College. (Read February 9, 1959). This paper relates to the detection of a pulsed signal received upon a background of noise. In a paper presented to the Nova Scotian Institute of Science in 1957 by M. R. McKay and H. S. Heaps it was shown that a theoretical analysis could predict the value of the greatest signal-to-noise ratio obtainable by the use of any linear filter. By signal-to-noise ratio was meant the ratio of signal energy to noise energy present in a finite time sample of the filter output.

The present paper describes three simple types of electrical filter, namely the third-order Butterworth, Tchebycheff, and Bessel filters. The properties of each may be described in terms of a single parameter. It is shown that in each case there is a proper choice of filter parameter that leads to signal-to-noise ratios within a few percent of the theoretical maximum.

Degraditive Studies on λ -Carrageenin. By K. Morgan, Atlantic Regional Laboratory. (Read March 9, 1959). Carrageenin, the commercially important mucilage present in some red algae, is now known to contain two main components. One of these, K-carrageenin, is responsible for the gelling properties of the mucilage, and its principal structural features have previously been determined.

Up to the present, the nature of the other component, λ-carrageenin, has been rather obscure. In a recent re-examination, λ-carrageenin was subjected to partial acetolysis. A new disaccharide, identified as 3-O-α-D-galactopyranosyl-D-galactose, and a new trisaccharide, provisionally identified as O-α-D-galactopyranosyl-(1→3)-O-α-D-galactopyranosyl-(1→3)-D-galactose, were isolated. Periodate oxidation studies were also carried out, and showed the presence of more than one type of linkage in the polymer.

The structure of the polysaccharide is discussed in the light of this new evidence.

Some Aspects of Wood Chemistry. By T. J. Painter, Atlantic Regional Laboratory. (Read March 9, 1959). About 150 years ago, wood was believed to be a homogeneous chemical substance, but since that time it has come to be recognized as a very complex system of high-polymeric substances. The development of the concepts of cellulose, hemicellulose, lignin, and pectic material is traced from the early discoveries of Braconnot, Payen, and Schulze up to the present time. The distribution of these components in and around the cells is described, and some modern views of their chemical structure are presented. The question whether cellulose is uniform throughout Nature is discussed in the light of recent research into the origin of mannose residues in softwoods.

Spectrofluorimetric Analysis of Skin in Vivo. By J. A. McCarter, Dalhousie University. (Read April 6, 1959). A method has been developed which permits the determination of the emission spectrum of fluorescence of minute quantities of carcinogenic hydrocarbons in the skin of the living mouse. The method makes use of the spectrofluorimeter previously described by McCarter, and the Beckman ratio recording Spectrophotometer. Applications of the method will be described.

Microwave Breakdown in Xenon and Krypton. By G. F. O. Langstroth and A. D. MacDonald, Dalhousie University. (Read May 11, 1959). The electric fields required to initiate an electrical discharge through pure xenon and pure krypton have been measured at 2800 Mc/sec in a pressure range from 0.1 to 100 mm. of mercury. The experimental method is outlined and the details of an ultrahigh vacuum system are presented. Pressure measurements are discussed. The electric fields for breakdown have been observed to vary with pressure from 200 to 1000 volts/cm. and conclusions are drawn regarding the effects of traces of impurities upon the breakdown fields.

Interaction Between Kinetin and Indole Acetic Acid in the Control of Bud Reactivation in *Splachnum ampullaceum* (L.) Hedw. By K. E. von Maltzahn, Dalhousie University. (Read May 11, 1959). Apical dominance in lateral bud reactivation and basal regeneration have been found in the gametophore of this moss. These effects of the apical region can be replaced by means of the application of proper concentrations of Indoleacetic acid to the tips of decapitated gametophores. Simultaneous application of Kinetin and Indoleacetic acid to the tips of decapitated plants shows that Kinetin counteracts the inhibitory effects of auxin on bud reactivation while it does not counteract the effects of auxin on basal regeneration. It appears, therefore, that these two systems of correlation are not mediated by the same mechanism.

MICROFILM SERVICE

The Proceedings of the Nova Scotian Institute of Science, 1863-1954, volumes 1-23, are now available on microfilm from THE CANADIAN LIBRARY ASSOCIATION, 63 Sparks Street, Ottawa, Canada. Prices on request.

Below are listed the volumes as they are arranged on the reels. Each reel of film may be purchased separately.

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HALIFAX, NOVA SCOTIA

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Editor: H. S. Heaps
Editorial Board: Dixie Pelluet, J. A. McCarter and J. R. Dingle
Printed for the Institute by Rolph-Clark-Stone-Maritimes, Limited
Date of Publication: March, 1962

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PROCEEDINGS
OF THE
Nova Scotian Institute of Science

VOL. 25 - PART 2

A FOREST CLASSIFICATION FOR THE MARITIME PROVINCES

O. L. Loucks
Forest Research Branch, Department of Forestry, Frederiction, N, B.

(Received for publication, February 8th, 1961)

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INTRODUCTION

The standard reference for regional forest descriptions in Canada for over twenty years has been *A Forest Classification of Canada*, prepared by W. E. D. Halliday (1937). The widespread use of this work as a reference and as a means of broad comparison reflects its importance and the need it filled. Recently, increased knowledge of the forests of Canada led to the revised classification by J. S. Rowe (1959), titled *Forest Regions of Canada.*

Forest descriptions covering large continental areas necessarily require a broad scale in both mapping and presentation of detail. In the maritime provinces of New Brunswick, Prince Edward Island, and Nova Scotia, however, coastal influences and abrupt changes in elevation result in marked differences in forest composition and succession within relatively short distances. Detailed descriptions and a large-scale map are therefore a necessary aid in evaluating the significance of these differences for forest management.

The classification put forward in this paper is intended to provide the detailed descriptions for local use. The underlying principles are specific to the objectives of classification discussed in another section. Suffice it to say that both the criteria used and the scale of mapping are patterned after Rubner and Reinhold (1953), whose forest classification for Europe is sub-titled *A Basis for a European Silviculture.* Similarly, the classification described here is intended to provide a basis for a "Maritime Silviculture". To do this, it should distinguish general levels of productivity and the kinds of silvicultural problems such as competition, wind, and fire that may be associated with a particular geographic area. These are a few of the attributes used in *A Forest Classification for the Maritime Provinces* to distinguish geographical units, each characterized by specific relationships between the vegetation, climate and soil. The classification is therefore a regional basis for site classification and forest management.

Although the method adopted here differs from that used in *Forest Regions of Canada*, the reservations noted by Rowe (1959) with respect to classification in general are valid. The maps and descriptions provided are only as good as the knowledge available at the time of writing. As more information accumulates, revision is to be expected. In addition, clearly distinguishable regions are not to be expected in all areas. The criteria used in the classification have been chosen to describe the gradations from one geographic area to another, providing at the same time the arbitrary scales along which regional boundaries can be located. The use and limitations of this approach are described in the following Section.

Most of the forest descriptions were made by Dr. I. C. M. Place and Prof. H. D. Long in field work from 1952 to 1954, and by Prof. Long and the writer after 1955. Published descriptions were used where available, as were observations by other foresters and ecologists. Mr. W. G. E. Brown contributed to the method followed in formulating the classification.

BASES OF FOREST CLASSIFICATION

A fundamental principle in geography is that there is no natural system of regions inherent in the nature of the world. This principle applies equally to forest classification. A system of regions, forest or otherwise, can be judged only in relation to the purpose for which it is required (Whittlesey, 1954), and the criteria used as the basis must be measured in terms of usefulness to man (Hartshorne, 1939). In forest classification, criteria are required that ensure the greatest advantages to the practice of forestry.

Classifications Reviewed

Early in the last century, plant geographers began developing methods for describing and classifying the vegetation of the world. Their objective was to outline the regions characterized by certain groups of plants. Plant distributions were the main criteria, and the resulting classification was intended to serve those interested in the vegetation. A recent trend in vegetation classification is that proposed by Braun-

Blanquet (1921, 1932) and by Passarge (1954). It is entirely phyto-sociological, and is determined according to the organization of the plant community.

Other attempts to account for the distribution of vegetation have been based on climatic data. The methods used by Köppen and Geiger (1936) and Thornthwaite (1931, 1948) are based on measured values of temperature and precipitation and represent a classification of climate only. Although there is a close relationship between climate and plant distribution, the species in widely separated areas of similar climate are never the same. Regardless of the similarity in climate, if different species are present, there is a difference in the relationship between the vegetation and climate. A classification of climates alone is therefore not satisfactory for forestry purposes.

Recent forest classifications: In preparing *A Forest Classification of Canada,* Halliday (1937) followed a third major system, that of Weaver and Clements (1929). The Forest Formation, a major unit of vegetation produced and controlled by climate, is the basis of the classification. Halliday treated as Forest Regions those portions of Canada dominated by one Forest Formation. In application, he used the "presence of certain tree species", the climax dominants, as the criteria for delineating his regions. The regions were then subdivided into Forest Sections on the basis of a broad uniformity of the forest associations, which he attributed to features of topography, soil, bedrock, and climate.

In a classification of the deciduous forests of North America, Braun (1950) placed most of the Maritime Provinces in her New England Section of the Northern Appalachian Highland Division, Hemlock—White pine—Northern Hardwoods Region. She included the Acadian Forest Region described by Halliday, and excluded only the Boreal Forest in northwestern New Brunswick. She used the 'Forest Region' to denote a natural entity whose boundaries are determined in part by "the limits of the more or less continuous ranges of characteristic species". Physiographic boundaries were used where information on the vegetation was insufficient for locating a regional boundary.

A more detailed classification of the forests in New England was prepared by Westveld and a committee of the Society of American Foresters (1956). Five Vegetation Zones are distinguished within the New England Section recognized by Braun. The boundaries of the Zones were determined by mapping groups of forest types possessing similarities of site and several key species. Western New Brunswick is bordered by a single heterogeneous Zone, the Spruce — Fir — Northern Hardwoods, although Hawley and Hawes (1912) had distinguished a Northern Hardwood Region in the Aroostook Valley of northern Maine.

Methods based on site classification: Other approaches to forest classification have resulted from the use of forest regions as a basis for site classification. In describing a system of site classification for universal application, Hills (1950) established the Forest Site Region as a broad, integrated pattern of soil sites within which the potential forest production could be compared. He states that it is a climatic region, defined by the occurrence of certain cover types in particular successional sequences.

Earlier, Heimburger (1934) had divided the site types in the Adirondack region into three geographical series, corresponding to floristic provinces, but based on flora, the soils, and the forests. In effect, he established three site regions, but probably at a more detailed scale than that used by Hills. Both investigators have successfully linked site classification and broad forest classification by formulating regions on the same principles as those governing their site classification. In this way the site region is designed so that the relationship between the vegetation and the physiography tends to follow a definite pattern within the region (Hills, 1952). The range in vegetation and climate acceptable within a site region is governed by the scale of the site classification. Although Hills and Heimburger used different approaches, they adopted somewhat similar scales of classification and set off site regions with comparable ecological amplitudes. Various approaches to site classification can be applied within such a framework.

The Classification for the Maritime Provinces

Classification may be achieved by studies carried out on a broad scale, proceeding to subdivisions from the top down, or it may be obtained by working from a detailed level to larger units. Because intensive silviculture and management requires a detailed scale, the small unit is a logical building stone for a classification designed to provide a basis for silviculture and yield predictions. The site type has been adopted here as the small, basic unit.

Definition of concepts: To avoid misinterpretation of the concepts in this section, the intended meaning of each will be reviewed briefly. The first is the term 'site type'. The British Commonwealth Forest Terminology (1953) defines 'site' as "the complex of physical and biological factors for an area which determine what forest or other vegetation it may carry". This statement specifies that the forest is presumed to result from a complex of physical and biological factors. The 'complex' cannot include the forest as a biological factor if it is also the result. The Commonwealth definition is adopted therefore, with the restriction that 'biological factors' include only soil microbiology and such related aspects of plant life as provide physical requirements of the tree community. The 'site type' is the class of relatively similar sites that forms a mappable unit.

The term 'association' is not to be construed in a restricted or technical sense. The definition adopted is that of the Oxford Universal Dictionary in which 'association' is "the being associated", or "occurring in combination with". Applied to forest stands it describes a recurring community of one or more tree species (Rowe, 1959).

The Oxford definition of a 'classification' specifies a systematic arrangement into classes according to a method. Cover types and site types are examples of such classes as applied to forests, but they are necessarily arbitrary abstractions at a local level for a specific purpose. In a similar way, forests may be classified for other purposes at a regional level by applying criteria over larger areas.

Another concept is the use of 'region' in a general sense. Whittlesey (1954) and Hartshorne (1939) indicate that the term 'region' as widely understood in geography implies an area of any size "throughout which accordant areal relationship between phenomena exists" (Whittlesey, 1954). Specific regions are singled out only when specific criteria are applied and the area is found to be relatively homogeneous in terms the criteria. Regions such as the Districts and Ecoregions in the following text will be distinguished from the general expression by a specific designation. 'District' is the term commonly used to designate a subdivision of a region identified by secondary criteria.

Definition of the proposed units: The site type, as a recognizable, recurring unit of mainly physical factors, provides the unit within which to make comparisons of forest conditions. A zonal site type, identified broadly as a well-drained, sandy-loam on a mid-slope position, can be recognized whether the vegetaton is sugar maple, spruce and fir, or abandoned pasture. When the surrounding relief and soil minerology are also comparable, differences in the lesser vegetation and in the composition of the old-growth forests can be used to characterize regions.

A descriptive term to denote regions recognized by vegetation in relation to these environmental criteria may be obtained by applying the prefix 'eco-'* to the term 'region'. 'Encoregion' is proposed therefore as the geographic unit within which ecological relationships between species and sites are essentially similar, and within which silvicultural treatments may be expected to obtain comparable results. Procedures for delineation of the Ecoregions follow.

The large size of the Ecoregion necessitates geographically limited subdivisions, both as a convenience in applying the classification, and as a means of reducing the range of internal ecological variation. The subdivisions may be distinguished on the basis of physical patterns of relief, texture of the predominating soil, type of bedrock, or a drainage pattern. Each of these criteria relate to the preponderance of a particular site type or group of site types. The subdivision so recognized is called a 'Site District'.

For broad comparison of the predominating tree species, a larger unit than Ecoregion is useful. The Forest Zone has been adopted for this purpose. It groups together Ecoregions showing affinities of dominant species composition. Ecoregions grouped in this way, and extended to other parts of Canada form broad belts, or zones, at a scale similar to that of the regions used by Halliday (1937).

Methods and criteria: The field records for most of the forest descriptions consisted of species lists with observations

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*From the Greek *oikos*, house, understood in the sense of 'mutual interrelations between organism and environment'.

on abundance and quality. Trees, young growth, shrubs and herbaceous vegetation were observed as a unit. Observation points were located throughout the Maritime Provinces in the course of a detailed canvass along county roads. Most of the observations were on well-drained sites, but cross-sections of the vegetation from ridgetops to valley bottoms and swamps were studied. Soil texture, presence of bedrock near the soil surface, drainage conditions and local relief were noted. Records were kept on the distribution limits of the tree species as well as for many shrubs and herbs. Distribution data from the observation points were supplemented by forest inventory records, low-level flying, and continuous notes of roadside species distribution.

In the course of the work, the more outstanding differences in species—site relationships and broad species distribution patterns became evident. Particular attention was then directed to observation of the gradation between areas of widely different stable forest. Except along the occasional abrupt topographic boundary, no sharp break in vegetation pattern could be observed. Owing to the magnitude of the gross differences in forest conditions, the gradation between sugar maple — beech forest, and spruce — fir must be broken into several arbitrary steps. Characteristics of the tree, shrub, and herb species on the zonal site are a means of observing this gradation. The variation that is tolerated within the zonal site type in any one area may be used to break the gradient on the zonal sites into segments. Each segment constitutes an Ecoregion.

The Site District and Forest Zone are secondary units derived from the Ecoregion. The criteria for their determination have been indicated in the definition of these units. The Site Districts, although identified by geographic location and the distribution pattern of site types, remove some of the variation within the Ecoregion, but they too grade from one into the other. Criteria for the identification of the site type, on which the Ecoregion is based, are discussed elsewhere.*

Discussion; Ultimately, the most critical test of a forest classification will be the success of the silviculturist in obtaining relatively uniform responses from a species, or a mixture of species, following a particular treatment anywhere in one region. If the regions are established with attention to this objective, they will provide a natural basis for silviculture. If, however, differences in silvicultural response are encountered, as may be anticipated in areas where information on the vegetation and forest succession is lacking, corrections must be made in the delineation of the regions. Usefulness for silviculture, manament, and site classification is proposed as the primary objective of a classification for forestry purposes.

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*Loucks, O. L. 1956. Progress Report: Site classification, Acadia Forest Experiment Station. Forestry Branch, For. Res. Div., Ottawa. Unpublished.

————————. 1957. Site classification during 1957 at Acadia and Green River Forestry Branch, For. Res. Div., Ottawa. Unpublished.

The importance of an ecological basis for silviculture has been stressed by Toumey and Korstian (1947) and by Lutz (1957). If ecological relationships and responses are to be understood in the silviculture of individual stands, it follows that the same relationships must be used in arranging large areas of forest land into regions for forestry purposes. Differences in the composition and vigour of competing vegetation impose major differences in the silviculture of two otherwise similar stands. Similar differences on zonal site types in widely separated parts of the Maritime Provinces are equally important for silviculture and should be distinguished in establishing the Ecoregions.

A special effort has been made to describe the undisturbed forests, in a belief that they best express the long-term influences characterizing each Ecoregion. These influences also control the growth and development of stands under intensive management, where, because of the disturbance, some characteristics of the vegetation are less well expressed. Other features, such as the abundance and vigour of competing shrubs and ground vegetation can be observed only in disturbed stands.

The resulting classification differs from that in *Forest Regions of Canada* (Rowe 1959) primarily in the application of criteria to the site type and synthesis of the regions from a local scale. The groups of Ecoregions, the Forest Zones, are comparable to the Forest Regions described by Rowe, but the method used in the Maritime Provinces is not designed for continent-wide comparisons. The objective of this classification differs little from that of Hills (1950, 1952), but there are distinctions in the means by which the objective is attained, and in the size of the region adopted. The 'Site District' is the same in both classifications.

Because the Ecoregion is not intended as a discrete or natural entity, the boundaries are not always sharp. A need remains for factorial studies of the ecological variations involved. Detailed analysis of data will be required to prove or disprove the existence of natural units or distinct boundaries except along a break in the physiography. So many facets of the vegetation are considered in different places that individual Ecoregions will not necessarily be different in all aspects of the vegetation. Special groupings of Ecoregions will therefore be useful for particular applications such as yield prediction and cull studies. Most important, however, is the recognition of forest classification as a multiple-level phenomenon, requiring the cover type and site type to be an integral part of larger units. The present treatment is limited to description of the larger, regional units, but should be viewed as the basis for pratical site classification at a local level.

PHYSICAL FEATURES AND CLIMATE

No forest classification would be complete without some attempt at an accounting for the geographic distribution of tree and shrub species in terms of environmental influences. The description of physical features and climate that follows is intended to provide background information for the discussion that appears with the forest descriptions.

Relief

The Maritime Provinces have a total land area of 51,237 square miles, of which about 90 per cent is either forested or is potential forest land. Most of this area is in the form of a barrier between the Atlantic Ocean and the Gulf of St. Lawrence, and a maritime climate characterizes all of Nova Scotia, Prince Edward Island, and the southern part of New Brunswick. Central and northern New Brunswick tend to a continental climate.

The climate, and consequently the distribution of forest species in the Maritime Provinces, is strongly influenced by the relief illustrated in Figure 1. Few of the uplands are high, but they rise and fall quickly, exerting a profound influence on the marine air masses. The major physiographic features have been named and described by Putnam (1952). Four prominent physiographic units may be recognized in New Brunswick: the Northwestern Plateau, the Central Highlands, the Southern Uplands, and the Eastern and Central Lowlands. The Northwestern Plateau is a strongly dissected peneplain of folded and metamorphosed sedimentary rocks. An immense granite intrusive with a skyline above 2,000 feet in elevation forms the Central Highlands. The Southern Uplands consist of the low mountains along the Bay of Fundy rising to 1,400 feet, the Kingston and Belle Isle Ridges to the north, and the broken uplands west of the Saint John River. The Eastern and Central Lowlands are a plain of horizontally stratified sedimentary beds, almost entirely below 500 feet in elevation. Prince Edward Island is a continuation of these lowlands, with no part more than 500 feet above sea level.

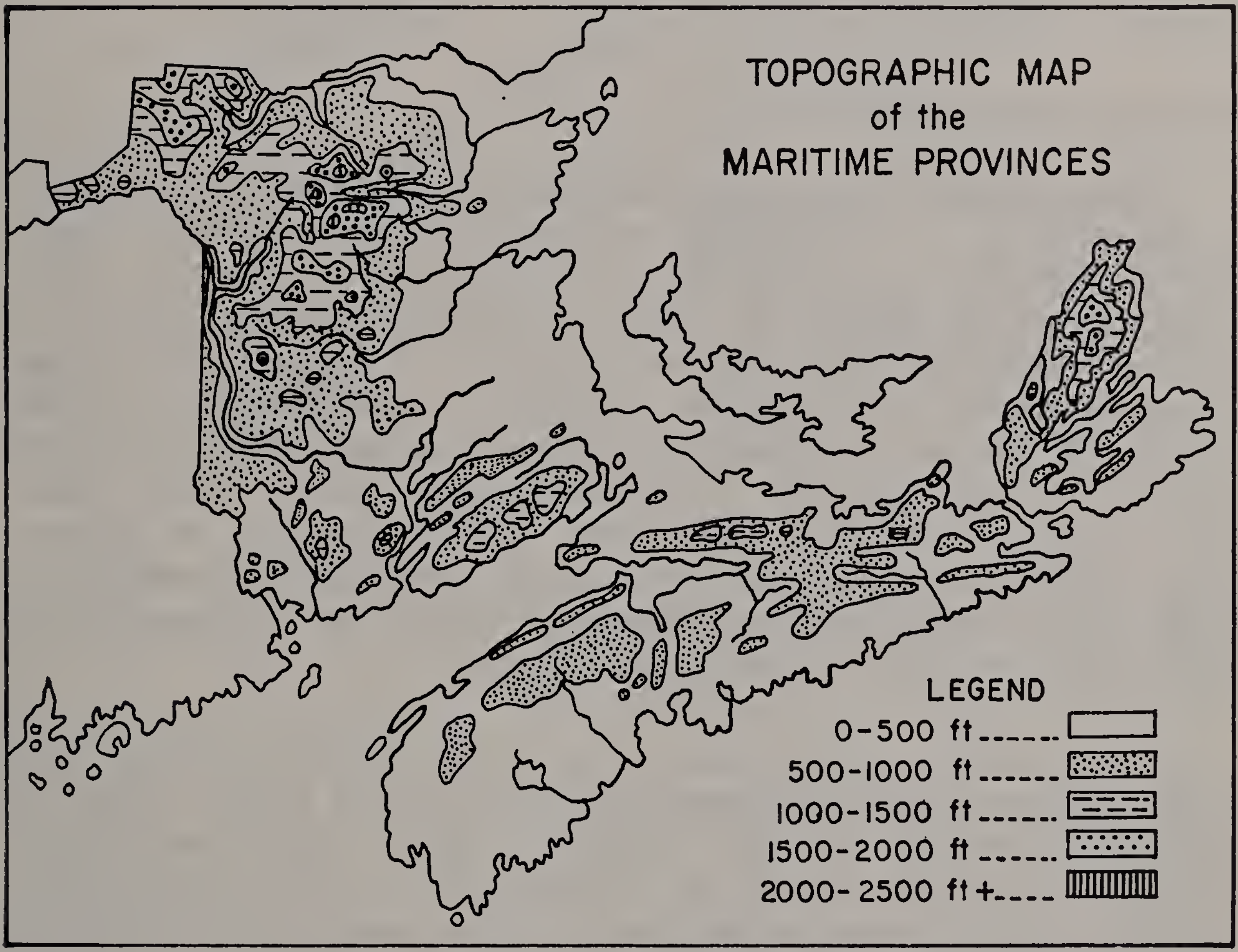

Fig. 1. Outline map of the Maritime Provinces illustrating the irregular configuration of uplands.

Nova Scotia is dominated by three systems of uplands: the Atlantic Uplands, the Cobequid Mountains and Pictou — Antigonish Highlands, and hills and mountains on Cape Breton Island rising from the south to the Northern Plateau. The broad, low tableland of the Atlantic Uplands consists of an inclined surface with a granite core, increasing in elevation toward the north at about 15 feet per mile to the brow of South Mountain. The Cobequid Mountains and the Pictou—Antigonish Highlands rise above 1,000 feet in a few places to form a range of low mountains nearly 160 miles long. On Cape Breton Island, the Southeastern Upland, numerous hills and mountains, and the Northern Plateau form a series of landforms increasing in elevation to the north and culminating at 1,500 to 1,700 feet. The lower elevations in Nova Scotia are occupied by the Northumberland Coastal Lowlands (an extension of the Eastern Lowland of New Brunswick) and a system of valleys and lowlands extending from Annapolis to Sydney.

Geology and Soils

Most of the relief can be related to the bedrock geology of the region. A simplified geological map, modified from recent maps of the Geological Survey of Canada (1949, 1955) is illustrated in Figure 2. Granites and ferromagnesian intrusives comprise most of the uplands. A large part of the Paleozoic slate and argillite bedrock in northwestern New Brunswick forms a strongly dissected plateau which, in the vicinity of the granitic intrusives, rises above 2,000 feet. Precambrian quartzites often form the approaches to upland areas. The more recent horizontally stratified sandstones, shales and conglomerates (mostly Triasaic and Permo-Carboniferous) are limited to the lowlands.

The granitic uplands have tended to weather slowly and recent glaciation has produced shallow, stony soils. The ice advance left much of the bedrock bare in these areas, and lithosolic soils are common. Although the ferromagnesian intrusive and volcanic rocks are almost as hard as the granites, they have weathered to fine-textured materials and the soils are richer. The argillite and slate beds of the Precambrian quartzite and slate group have weathered more quickly to produce a thick mantle that was moulded into hundreds of drumlins during glaciation. The quartzites weathered slowly, and although frequently covered by a soil mantle from the adjacent slates and argillites, bare bedrock and shallow, coarse soils are common.

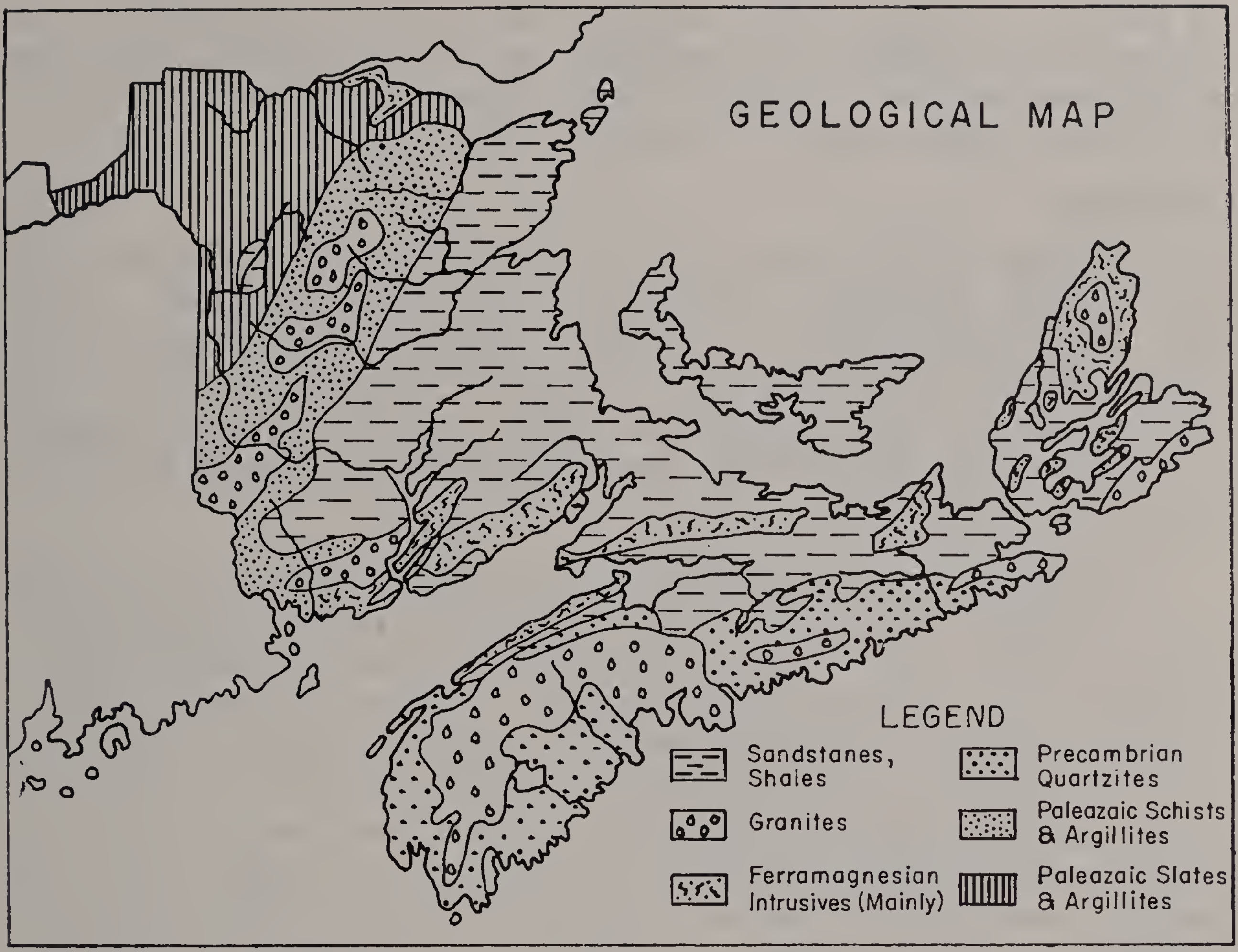
GEOLOGICAL MAP
LEGEND
Sandstones, Shales
Granites
Ferramagnesian Intrusives (Mainly)
Precambrian Quartzites
Paleazaic Schists & Argillites
Paleazaic Slates & Argillites

Fig. 2. A simplified outline of the geology of the Maritime Provinces.

The older Paleozoic rocks in central and northwestern New Brunswick are Ordovician, Silurian, and Lower Devonian in origin. Many of those in the northwest contain lime in the form of calcite streaks. Metamorphosis of these beds has resulted in a strong vertical cleavage. This and the soft nature of the rock has allowed even small streams to cut deep, V-shaped valleys, and extremely rugged topography has resulted. For the same reasons, the advance of ice over the area did not leave a scoured bedrock, but rather a rubbly, shallow till, formed from crushed slate and argillite. The schists and argillites in central New Brunswick are less prone to vertical cleavage and the soils are often shallow.

The horizontally bedded sandstones and shales are more recent, mostly Mississippian and Pennsylvanian in origin. Conglomerates, coal neds, and occasional limestones may be found with them. Most of the beds are not dissected greatly by stream action and the soil mantle tends to be shallow. A compact, basal till was smeared over the bedrock during the last glaciation, but a sandy drift, probably of ponded origin, now covers large parts of the area.

Climate

Because of the distribution of land and water masses, climate in the Maritime Provinces is unusually variable. Putnam (1940) states that in winter, cyclonic storms pass along the southern border inducing invasion by cold air from the interior of Canada. In summer, the storms commonly pass to the north, drawing with them the warm, humid air from the south and southwest.

The climate of northern New Brunswick may be described as continental, with great fluctuations in daily and seasonal temperatures, but with a relatively uniform precipitation. Southern Nova Scotia, being under a marine influence, has a smaller range of temperature and more rainfall. The continental portions of the Maritime Provinces usually have an earlier spring than the marine locations, because of the long period required for appreciable warming of the ocean; but the marine areas have a longer autumn. Despite the absence of climatic records, Putnam (1952) lists two areas, the Central Highlands of New Brunswick, and the Northern Plateau of Cape Breton Island, as being sufficiently elevated to warrant separation as distinct climatic regions. There are several other uplands with less extreme elevations in which the climate is also much modified from that of the surrounding lowlands.

Although Putnam describes eleven climatic regions in the Maritime Provinces, they are mapped without detailed attention to the effects of local relief and distance from the ocean on both temperature and precipitation. The fact that residents in the southcoast community of Yarmouth, Nova Scotia, maintain cottages and gardens fifteen to twenty miles inland from the coast to benefit from the warmer temperatures is as significant as meteorological records. Repeated observation of showers over moderately low uplands such as Kierstead Mountain in central New Brunswick are also relevant. With due reservation, such observations have been used as a guide in the interpolation of the temperature, precipitation, potential-evapotranspiration, and water deficiency data plotted in Fig. 3. These charts are intended only to supplement those

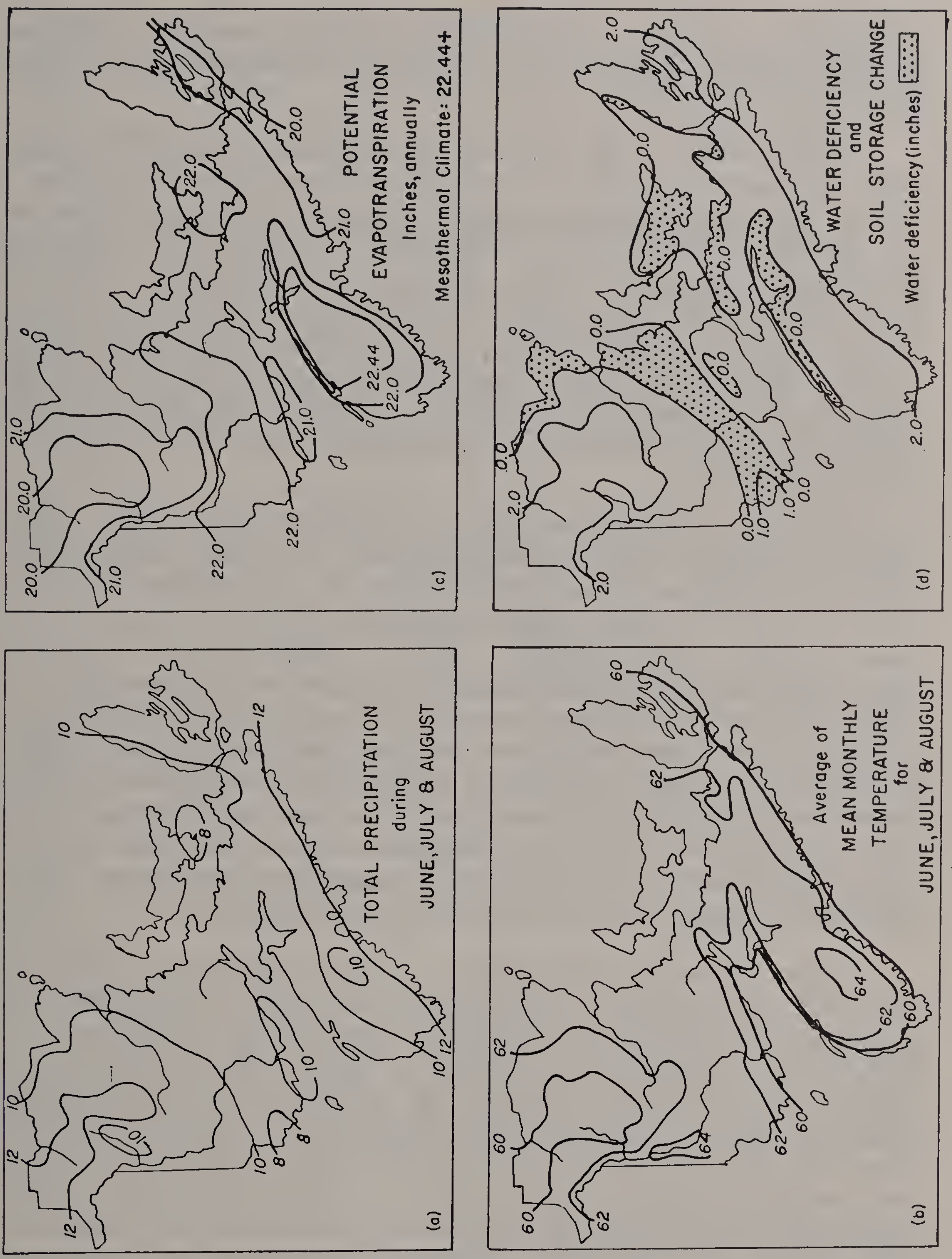

Fig. 3. Charts of climatic variables in the Maritime Provinces plotted from records of over 60 stations. (a) summer precipitation; (b) average summer temperature; (c) the potential annual water loss in inches through evaporation and plant transpiration, based on the latitude and mean temperature of the reporting station; (d) soil storage change, the withdrawal of moisture from the theoretical four inches stored in the soil when current precipitation fails to equal potential evapotranspiration. Water deficiency occurs after the four inches has been withdrawn.

published by Putnam (1940, 1952), and are based on published records of the Meteorological Division, Department of Transport (1940, 1954).

Comparison of the summer precipitation chart Fig. 3(a), with Putnam's chart of mean annual precipitation shows a strong contrast between summer and annual precipitation: the coastal influence on precipitation is much less apparent during the summer. The average of the mean monthly temperatures for June, July and August plotted in Fig. 3(b) shows correspondence with the abundance of tolerant hardwoods. Beech and sugar maple predominate where the mean summer temperature exceeds 64 degrees, but are more restricted to well-drained soils where the temperature is between 62 and 64 degrees.

Potential evapotranspiration (Thornthwaite 1931, 1948) obtains somewhat similar isopleths, but in a more refined way. In it, both temperature and latitude are taken into consideration to obtain a figure representing the annual pressure on the water supply. The central part of western Nova Scotia is distinguished by a Mesothermal Climate*, which according to Thornthwaite's classification is comparable to New England and Southern Ontario (Thornthwaite, 1948; Sanderson, 1948). A hardwood forest with oak is characteristic of this climate in areas with less precipitation than in western Nova Scotia. The complex of red spruce, hemlock, white pine and red oak in western Nova Scotia is thus a natural result of the Mesothermal Climate in an area of high precipitation.

Where summer precipitation is not sufficient to meet the monthly demand of evapotranspiration, the vegetation first borrows on moisture stored in the soil. This is indicated in Fig. 3(d) where the amount of water withdrawn from the theoretical supply stored in the soil (4 inches) is shown as Storage Change. In the areas of water deficiency, the soil storage has been depleted and rainfall is insufficient to provide for both evaporation and the transpiration of plants. The four inches of moisture estimated to be stored in the soil is an arbitrary figure applied to agricultural soils of moderately heavy texture. Coarse soils such as sands and sandy loams would not hold this much, and a greater deficiency results. Although a water deficiency of two inches is not thought serious for agriculture (Sanderson, 1948), there are differences in the forest vegetation in the Maritime Provinces which appear to be related to it.

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*A thermal province recognized by Thornthwaite and defined as having from 22.44 to 44.88 inches of potential evapotranspiration annually. Most of the Maritime Provinces are a Microthermal Climate with a P.E. between 11.22 and 22.44 inches annually.

ECOREGIONS IN THE MARITIME PROVINCES

In accordance with the principles of forest classification already outlined, Forest Zones, Ecoregions and Site Districts have been established throughout the three Maritime Provinces, New Brunswick, Prince Edward Island and Nova Scotia. The accompanying map shows the delineation of these units. The distinctive tree associations and climate of the Zones and Ecoregions are summarized in Table I. The descriptions which follow are primarily of the Ecoregions, although the latter are grouped by Forest Zones. Local variations within the Ecoregion are described under the District heading.

Sugar Maple — Ash Zone

Tolerant hardwoods distinguish the Zone, with sugar maple and beech predominating. Small representations of white ash, butternut, ironwood and basswood are characteristic. The Zone differs from the Sugar Maple — Hemlock Pine Zone in the presence of butternut and white ash as well as in such characteristic lesser plants as wild ginger, bloodroot, black raspberry, and maidenhair fern. In some aspects, the Zone is closely related to a similar forest in portions of Southern Ontario.

1. **Saint John River Ecoregion** (Carleton District)

A small area of forest, unique in the Maritime Provinces, is centered on the slopes to the Saint John River in western New Brunswick. In spite of considerable variation, only one District has been recognized; its description is included with that of the Ecoregion.

The occurrence of butternut, white ash, ironwood and basswood in an association dominated by sugar maple and beech distinguishes the Ecoregion. Red spruce and eastern hemlock are sparse, confined mainly to moist sites and steep slopes. Ill-drained lands with white cedar, black ash, red maple and white elm are common, as are spruce — fir — cedar

TABLE I. DISTINCTIVE FEATURES OF THE ZONES AND ECOREGIONS

Zone	Ecoregion	Characteristic species	Associated climate
Sugar maple—Ash		sM, Be, wAs*	Warm, dry
	(1) St. John River	sM, Be, I, wAs, Bu, Ba	,, ,,
Sugar maple—Hemlock—Pine		sM, Be, wP, eH, yB	mod. warm, mod. dry
	(2) Restigouche—Bras d'Or	SM, Be, bF, yB, wP, wS	Mod. cool, mod. dry
	(3) Magaguadavic—Hillsborough	sM, Be, wP, eH, bF, rS	Mod. warm, mod. dry
Sugar maple—Yellow birch—Fir		sM, yB, bF, Be	Cool, moist
	(4) Maritime Uplands	sM, yB, bF. Be, wS, rS, rM	,, ,,
Red spruce—Hemlock—Pine		rS, bF, eH. wP, rM	Mod. warm, mod. dry
	(5) Clyde River—Halifax	rS, wP, eH, rO, rM, bS, Be	Warm, dry
	(6) Maritime Lowlands	bF, rS, bS, eH, wP, rM, jP, wS, Be	Mod. cool, mod. dry
Spruce—Fir Coast		wS, bF, wB	Cool, wet
	(7) Fundy Bay	rS, bF, wB, wS, bS, yB, Mo	,, ,,
	(8) Atlantic Shore	wS, bF, bS, wB	,, ,,
Fir—Pine—Birch		bF, wB, wS, wP	Cold, moist
	(9) New Brunswick Highlands	bF, wB, wP, tA, wS, bS, jP, rS	Cold, mod. dry
	(10) Gaspé—Cape Breton	bF, wB, wS, bS	Cold, wet
Spruce Taiga		bS, bF, wS	Cold wet
	(11) Cape Breton Plateau	bS, bF, wS, wB, Mo	,, ,,

*Abbreviations of tree names are those adopted by the C.I.F., For. Chron., 1952.

swamps. The coniferous swamps and the stands of white spruce and cedar that reclaim much of the abandoned farmland contribute to the high proportion of softwood forest reported for this area by the Forest Inventory (1958).

The ground vegetation is distinguished by many species not found elsewhere in the Maritime Provinces; these include bloodroot, Goldie fern, four-furrowed Enchanter's-Nightshade and black raspberry. Sweet-cicely, spikenard, and a number of buttercups and violets are common. Competition is intense following a disturbance such as clear-felling, but sugar maple advance growth is usually abundant and gradually suppresses the herbaceous species.

Owing to the depth and quality of the well-drained soils, most of the hardwood lands have been cleared for agriculture, Fig. 4. The remaining forest is limited mostly to steep or stony lands and serves for farm woodlots. Quality sugar maple can be grown in two-log trees on fresh and moist sites, but white ash should be preferred for stony ridges. The excessive number of sugar maple saplings that become established following a disturbance is one of the silvicultural problems.

The combination of rich soils and a warm climate without excessive precipitation accounts for most of the distinctive features of forest and lesser vegetation. Sanderson (1948) shows a small part of western New Brunswick with a Moisture Index* below 80, the lowest in any part of the Maritime Provinces. Fig. 3(b) indicates the warm summer temperatures that are restricted to the core of this District. Thornthwaite (1948) shows parts of central Maine, 70 miles to the southwest, as a warm Mesothermal Climate (potential evapotranspiration above 22.44 inches). Fig. 3(c) shows southwestern New Brunswick to be similar. The warm temperature and relatively low moisture index combine to give the District a distinctive climate.

Well-drained heavy loams with shale fragments, and loams with sandstone fragments, are the most common soils (Stobbe and Aalund, 1944). Both are derived from the underlying shales and slates, broken locally by micaceous sandstones. Calcite veins contribute calcareous fragments in the parent material. Poorly drained soils are common. The well-

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*A term used by Thornthwaite (1931, 1948) to express moisture supply or deficiency in relation to water need.

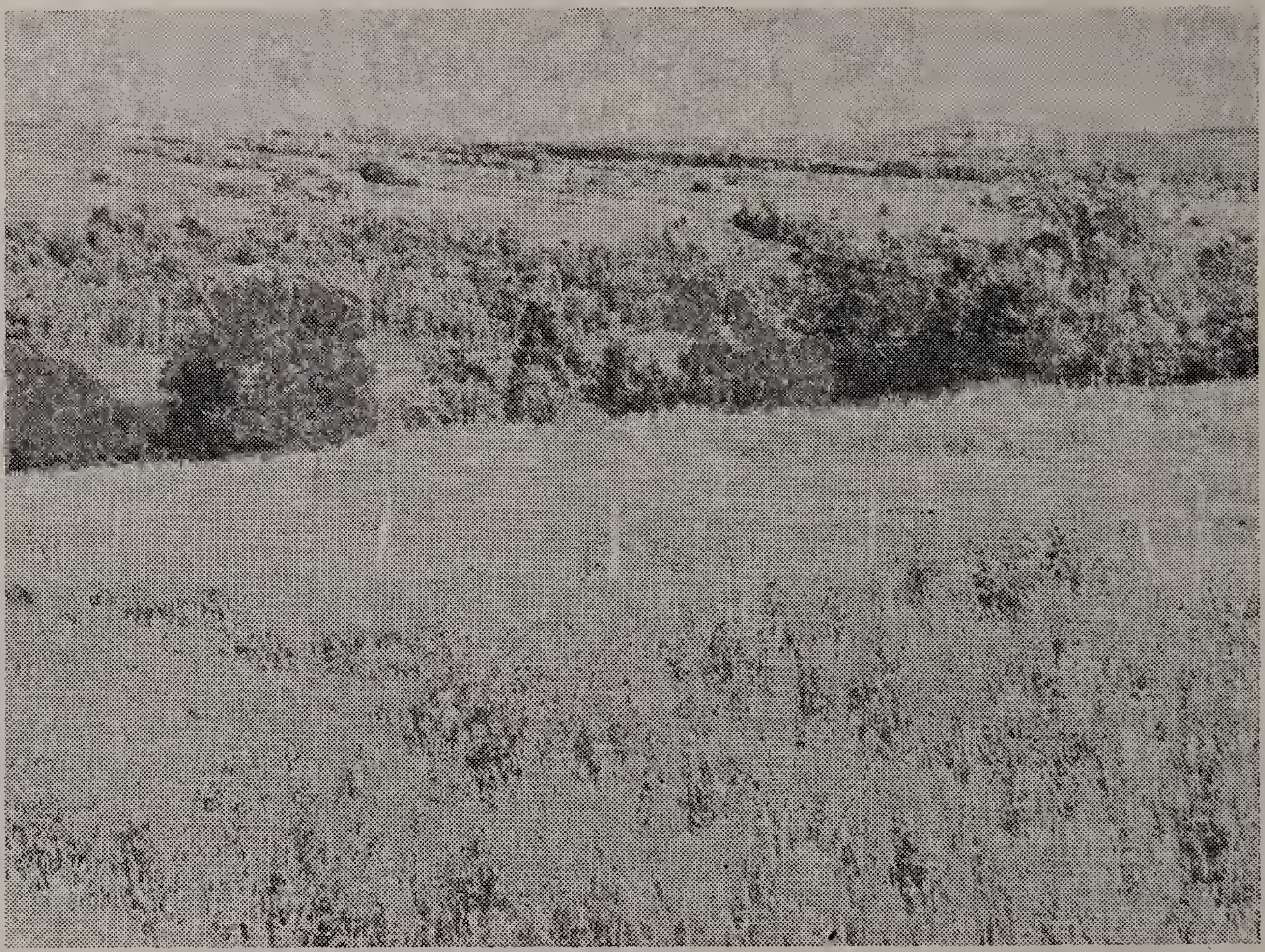

Fig. 4. Sugar Maple—Ash Zone; St. John River Ecoregion. Rolling agricultural lands north of Woodstock, N. B.; the St. John River is in the foreground. The scattered woodlots are highly productive for quality hardwoods.

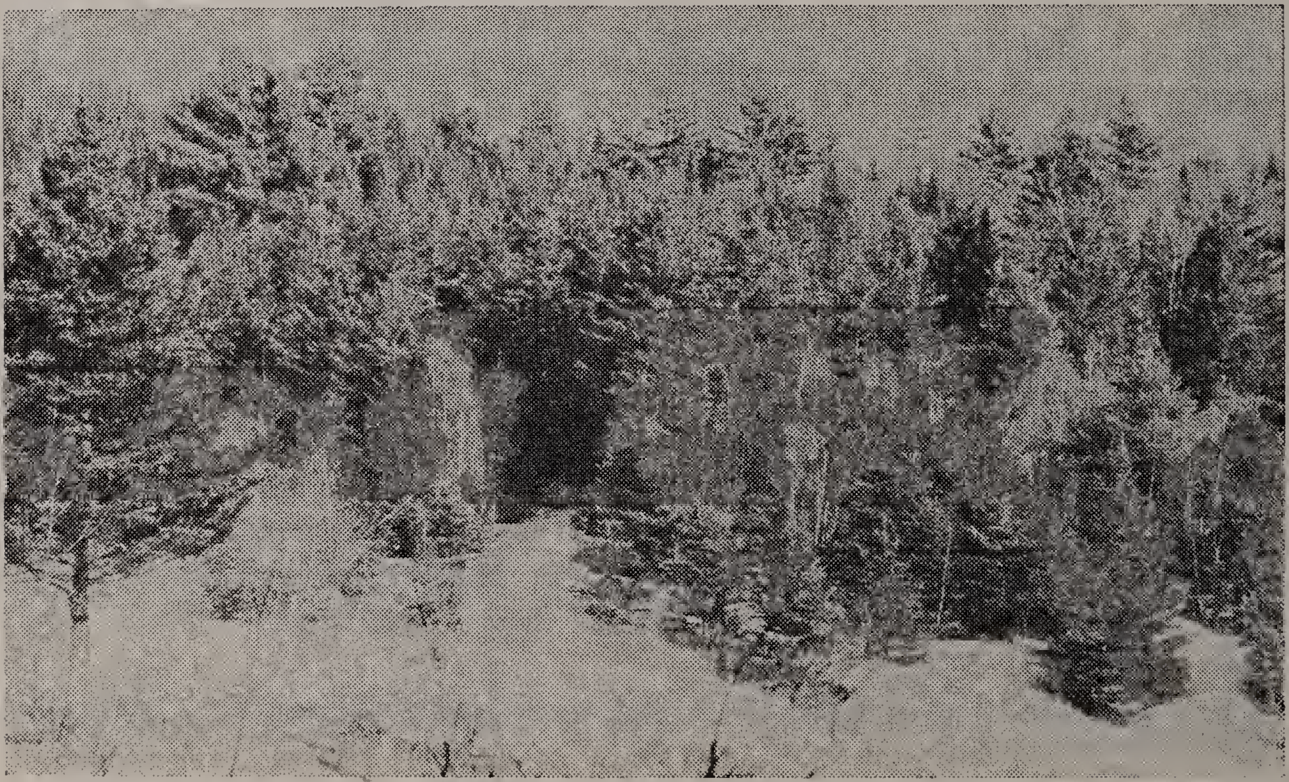

Fig. 5. White pine overtopping spruce and fir on a well-drained site in the Restigouche-Bras d'Or Ecoregion.

drained soils are classed as "minimal podsols" and are characterized by a duff mull humus, a thin, often discontinuous A_2, and a firm granular structure in the B horizon. In the southern part of the District, harder bedrock of schists and argillites predominates, broken by granites, shale and slate. Rough, stony soils of a lighter texture are common here, but the slightly calcareous tills found to the north also occur.

The District is bounded on the north and northeast by high elevations and a cool, humid climate. Rough topography and coarse soils border it on the south.

Sugar Maple — Hemlock — Pine Zone

Two Ecoregions are combined in this zone. One is northern and is characterized by spruce, fir and pine forests among scattered hardwood stands; the other is more southerly and tolerant hardwoods are found on a wider range of sites. Hemlock is sparse in the former, and common on slopes and valley bottoms in the latter. The soils are more strongly podsolized, and consequently the demanding species characteristic of the Sugar Maple — Ash Zone are rare.

2. Restigouche — Bras d'Or Ecoregion

Portions of the Upper Saint John Valley, the north shore of New Brunswick, and the lowlands of eastern Nova Scotia are grouped together in this Ecoregion. Poor quality tolerant forests of beech and sugar maple with scattered yellow birch are found on the higher land, but the slopes and valley bottoms are dominated by balsam fir, white spruce, black spruce, and white pine. The relation of pine to spruce and fir on upland sites is illustrated in Fig. 5. Red spruce and hemlock occur only locally, and wire birch is essentially absent.

The lesser vegetation is similar to the depauperate ground cover of northern coniferous forests. Wood-sorrel, wood fern, maianthemum and bunchberry predominate under softwood stands on well-drained sites. Dogtooth-violet, yellow violet and zigzag smilacina, common to the south, are rare. Beaked hazel is abundant under tolerant hardwoods where wood-sorrel and hobblebush are sparsely represented.

Well-drained sites that under natural conditions support softwood forest present little difficulty to the management of balsam fir, white spruce and white pine. The fir and spruce do not appear to be as long lived as in areas of higher precipitation, so that the pines are to be favoured with a spruce and fir understory. Of the hardwood species, yellow birch probably could be grown in one-log trees on most of the hilltop sites. The apparent susceptibility of the Ecoregion to fire places protection from fire or the use of fire in silviculture in a prominent role.

The outstanding climatic features are a relatively low summer temperature and a moderate summer precipitation. Average summer temperatures range from 60 to 62 degrees, Fig. 3(b), compared with 62 degrees and up in the Magaguadavic — Hillsborough Ecoregion and most of the Red Spruce — Hemlock — Pine Zone. A similar difference may be observed for potential evapotranspiration, Fig. 3(c). The summer precipitation and storage change data, Figs. 3(a) and 3(d), show the Restigouche — Bras d'Or Ecoregion generally without a water deficiency, and having between 10 and 12 inches of precipitation during the summer months.

The soils of this Ecoregion vary considerably and are described under the Site Districts. The relief is low and rolling, as most of the Districts occupy broad valley basins or low elevations on the rain-shadow side of uplands.

Edmundston District: Comprises the upper Saint John River valley, above Grand Falls. Balsam fir, white spruce and black spruce dominate uncleared portions of the valley bottoms, but white pine is sufficiently abundant to indicate that it once thrived. Hemlock and red spruce are rare.

Tolerant hardwood forests in which yellow birch is prominent border the District above the 800- to 1,000-foot contour interval. The site pattern is characteristic of a deep, broad valley with outlying hills. The soils are mainly loams and sandy loams derived largely from slate, argillite and quartzite. Most of the bedrock has a strong, vertical cleavage, locally with calcite veins. The strong relief and deep cleavage ensure good drainage, and tree roots frequently penetrate the bedrock. The valley-bottom soils have been greatly influenced by the material deposited in Glacial Lake Madawaska (Lee, 1955), which was centered in the District. Heavy, glacio-lacustrine clays and clay loams, as well as more recent alluviums, are found here. The gently rolling land has been extensively cleared, but some hardwoods remain on steep slopes and hilltops; softwoods occupy the poorly drained depressions.

Plaster Rock District: Located in the valley of the Tobique River where a particularly dry, cold, micro-regional climate prevails. Much of the valley is either so flat or so poorly drained that zonal sites are uncommon, but those observed tend to support tolerant hardwoods with balsam fir, and scattered white and red pine. Hemlock and red spruce occur locally, mainly on moist slopes. Black spruce, white spruce, and the pines characterize the cold, ill-drained flats. Pure stands of white spruce occur on abandoned famland.

Higher land, supporting mainly tolerant hardwoods borders the District on all sides. The red sandy-loam and clay-loam soils derived from Carbiniferous siltstone and shales contain some calcareous fragments, but tend to be acid throughout the profile. The heavy texture and gentle relief make for poor drainage. Droughty, gravelly-loam tills derived from slightly calcareous sandstones and conglomerates are also common. The preponderance of flat, sandy, or ill-drained sites influences both management and forest operations.

Restigouche District: The broad, strongly dissected valleys of the Restigouche and Upsalquitch river systems comprise the core of this District. Most of it is in the rain shadow of a 1200 to 1500-foot upland to the southwest. Yellow birch is common among the hardwoods; white pine, red pine and jack pine occur with spruce and fir on valley bottoms and lower slopes. A history of severe fires attests to the relatively dry climate.

The District is bordered by higher land on the west and south, and by less rugged topography on the east. The distribution of sites is dominated by the long steep slopes of the strongly rolling terrain. The soils are loams and sandy loams derived from argillaceous metamorphic rocks containing small amounts of lime. The deep cleavage of the surface bedrock permits good drainage and deep rooting. Coarse sandy and gravelly soils occur locally along the narrow valley bottoms. Repeated fires during the last 30 years have reduced some of the forest to intolerant hardwood species, but the soils are such that high productivity can be expected when a coniferous forest is restored.

Jacquet River District: Comprises gently rolling landforms on horizontally stratified bedrock along the south side of the Bay of Chaleur. The District is essentially a coastal plain below 500 feet in elevation, distinctly moderated by the Bay of Chaleur, and in the lee of the broad upland to the southwest. Tolerant hardwoods, with spruce, fir and white pine predominate. Red spruce occurs locally in the south; hemlock is sparse. The flat, frequently ill-drained, coastal portion is mainly coniferous, although black ash swamps are common.

Higher elevations, between 700 and 1,000 feet, coincide with the gradual predominance of coniferous species on the southwest. The soils are heavy marine and lacustro tills on the lowlands along the coast, and sandy loams derived from a complex of sandstone and argillaceous bedrocks farther inland. Large parts of the District have been either burned or recently settled.

Sevogle District: Situated on the eastern approaches to the New Brunswick Highlands. It is in the rain-shadow of the Highlands, but moist air masses often approach directly from the Atlantic. Sugar maple, beech, white pine and red spruce occur throughout, but extensive areas are entirely coniferous. Yellow birch is more abundant in the higher western half; hemlock is found mainly in the eastern portion. Dense spruce and fir, with scattered white pine and the occasional stand of jack pine, dominate the slopes and broad valley flats.

The low relief of the Eastern Lowlands borders the District on the east while higher elevations and a predominantly coniferous forest occur along the west. Light, sandy-loam soils derived from metamorphic schists and argillites are found in much of the wide band between the Lowlands and the Central Highlands, but stony loams occur locally. The District is suited to the production of one-log yellow birch in addition to red spruce, white spruce, and white pine.

Guysborough— Bras d'Or District: Comprised of a series of low hills on the eastern Nova Scotia mainland, and the central lowlands of Cape Breton Island. The District is sufficiently removed from the Atlantic Ocean to sustain warmer temperatures and lower precipitation than along the coast, but it is not as protected as the East River trench to the west. Much of the District was once cleared for sheep pasture and this land is reverting to white spruce with balsam fir.

Scattered stands of tolerant hardwoods remain, and hemlock and white pine are found locally. Red spruce is rare, usually on steep slopes or along water courses.

The District is bounded by the Antigonish lowland on the west, by a coniferous forest on the south, and by the moist uplands to the north. Several hills rising above 800 feet in elevation are excluded, and will be described in the Cape Breton Hills District. The bedrocks are variable, including granites and volcanics, and softer sandstones, shales and conglomerate. Most of the soils are sandy loams derived from both the hard metamorphics and the mainly siliceous sedimentary beds. Compaction of the surface horizons has resulted on soils used for sheep pasture, and this may lead to difficulty in forest management until normal aeration is restored.

3. Magaguadavic — Hillsborough Ecoregion

The inland portions of southern New Brunswick and central areas in Prince Edward Island and Nova Scotia support forests with much in common, and are considered together in the Magaguadavic — Hillsborough Ecoregion. Tolerant hardwoods, locally of good quality, are abundant on upland sites. Red oak and black cherry are widely distributed. Mainly coniferous forests are found on the steep slopes of narrow valleys, on broad valley bottoms, and on outwash plains. Balsam fir, hemlock, white spruce, red spruce and white pine predominate on the valley tills; white pine, balsam fir and black spruce on the sandy outwashes. Intolerant stands of red maple, wire birch and aspen are also prominent.

Species of the forest floor that distinguish the Ecoregion include dogtooth-violet, cucumber-root, yellow violet and zigzag smilacina. These plants are not limited to the Ecoregion, but are more widely distributed here and contribute to the distinctive nature of the vegetation.

The light-textured soils and coniferous lower slopes present little difficulty to forest management. White birch and other intolerant hardwoods occupy some of this land, but their replacement by spruce, fir and pine can be expected. The fir is not so long-lived or of as good quality as in other parts of the Maritime Provinces; 60 to 80-year-old stems are frequently decadent. Sugar maple, beech and red maple reproduction comprise the aggressive competition on tolerant hardwood sites. Quality sugar maple and yellow birch could be grown on some soils if suitable treatments were carried out (Jarvis, 1956). Much of the land has been cleared for agriculture and where it has reverted to white spruce (or in a few places white pine) these species do well.

The climate (Fig. 3) differs from that of the surrounding ecoregions in the low summer precipitation, warm summer temperature and high potential evapotranspiration. A water deficiency prevails throughout most of the Ecoregion, the LaHave District in Nova Scotia being the exception. Since water deficiency data were not available for stations indicating the high temperatures and relatively low summer precipitation, this exception may be an inadequacy of the available data.

Rolling, drumlinoid topography and moderately deep sandy-loam soils are frequent. Sandy outwash soils are locally abundant in southern New Brunswick.

Pokiok District: Located on the southwestern extension of the hard, granitic intrusive which forms the spine of the New Brunswick Highlands. The relatively high elevations of this District, occasionally up to 800 feet, create a more moist climate than is found on either the east or west. Although an abundance of conifers on middle and upper slopes distinguishes the District, it is nevertheless part of the Magaguadavic — Hillsborough Ecoregion. Red spruce and yellow birch are abundant, while much of the white pine is limited to the broad valleys.

The higher land coincides with the underlying granitic and metamorphic bedrocks to form the east and west borders of the District. Some of the soils are light and sandy, and are derived from coarse grey granite. Others are moderately heavy, stony, and slightly limy, and are derived largely from the slates, argillite and schist. The flat, sandy soils of the Becaguimec valley are derived from softer Mississippian sandstones and conglomerates. Much of the poorly drained land tends to form a neutral muck or swamp. Sugar maple and yellow birch are suitable for management on the uplands; red spruce, balsam fir, white pine, and white spruce will do well on the middle slopes, flats, and valley bottoms.

Magaguadavic District: Consists of a low-lying plain, mainly below 500 feet in elevation, and protected on the west by the higher land of the Pokiok District and on the south by uplands along the Bay of Fundy. The summer temperature and water deficiency charts in Fig. 3 indicate the warm, dry climate. Pine predominates on sandy outwash soils, and occurs in association with beech, sugar maple, red maple and red oak on the low ridges. Black ash, red spruce, cedar and red maple occur in the extensive swamps.

The eastern border of the District coincides with the limit of slightly limy loams, derived from slate, quartzite and calcareous shales, that cover much of the area (Wicklund and Langmaid, 1953). Higher land forms the limit on the north and south. Sandy and gravelly soils are common along the Magaguadavic River. Repeated burning has all but eliminated the former pinery that prevailed on dry to well-drained portions of the District. Although only locally abundant now, red pine and white pine are more suited to the climate and soil than spruce or balsam fir.

Mt. Pleasant District: Located on strongly rolling terrain to the east of the former, this District is similar in climate, but differs in its light granitic soils. Beech, sugar maple, red maple and red oak are characteristic. The white pine common with the hardwoods on slopes and ridges is illustrated in Fig. 6. Locally, it forms pure stands, sometimes with spruce and fir on the valley bottoms, but early records indicate that it was formerly more abundant. Red spruce and hemlock are common on slopes and in narrow valleys. Much of the District is now covered with poor quality hardwoods.

Shallow, gravelly-loam soils derived from hard igneous and metamorphic rocks cover most of the District. Slightly limy loams occur locally on the west. Sandy plains are found along the main drainages. On the north, the District is bordered by the heavy soils of the Central Lowlands, on the west by the somewhat limy soils of the Magaguadavic District, and on the south and east by coastal influences from the Bay of Fundy. White pine, red pine, and red spruce appear to be the most suitable species.

Grand Lake District: Comprises a series of lowlands and valley slopes along the Saint John River and the adjacent Grand Lake system. The micro-regional climate is moderated

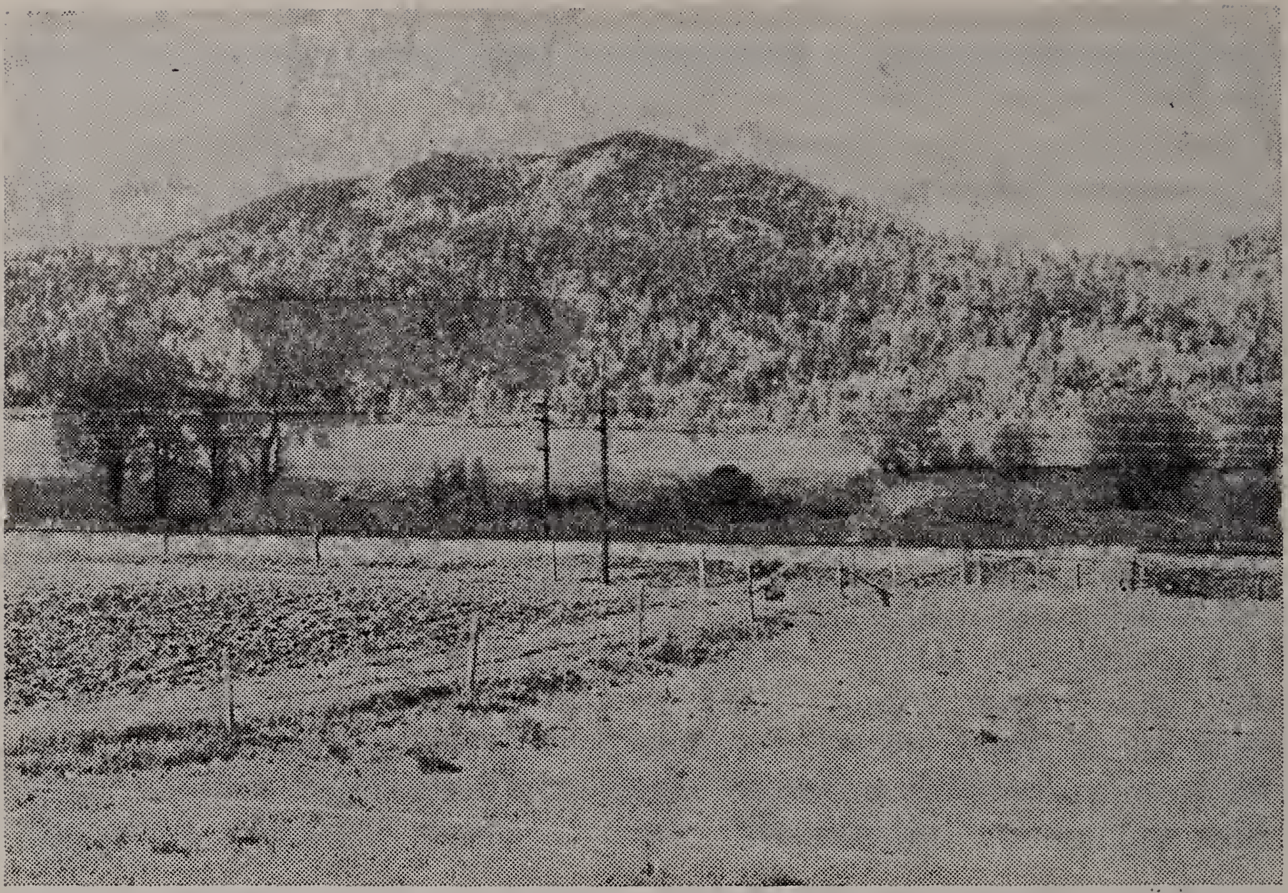

Fig. 6. Hills near Welsford, New Brunswick, illustrating the mixing of white pine with broadleaf species on slope sites. The patches of pure conifer indicate shallow, azonal soils.

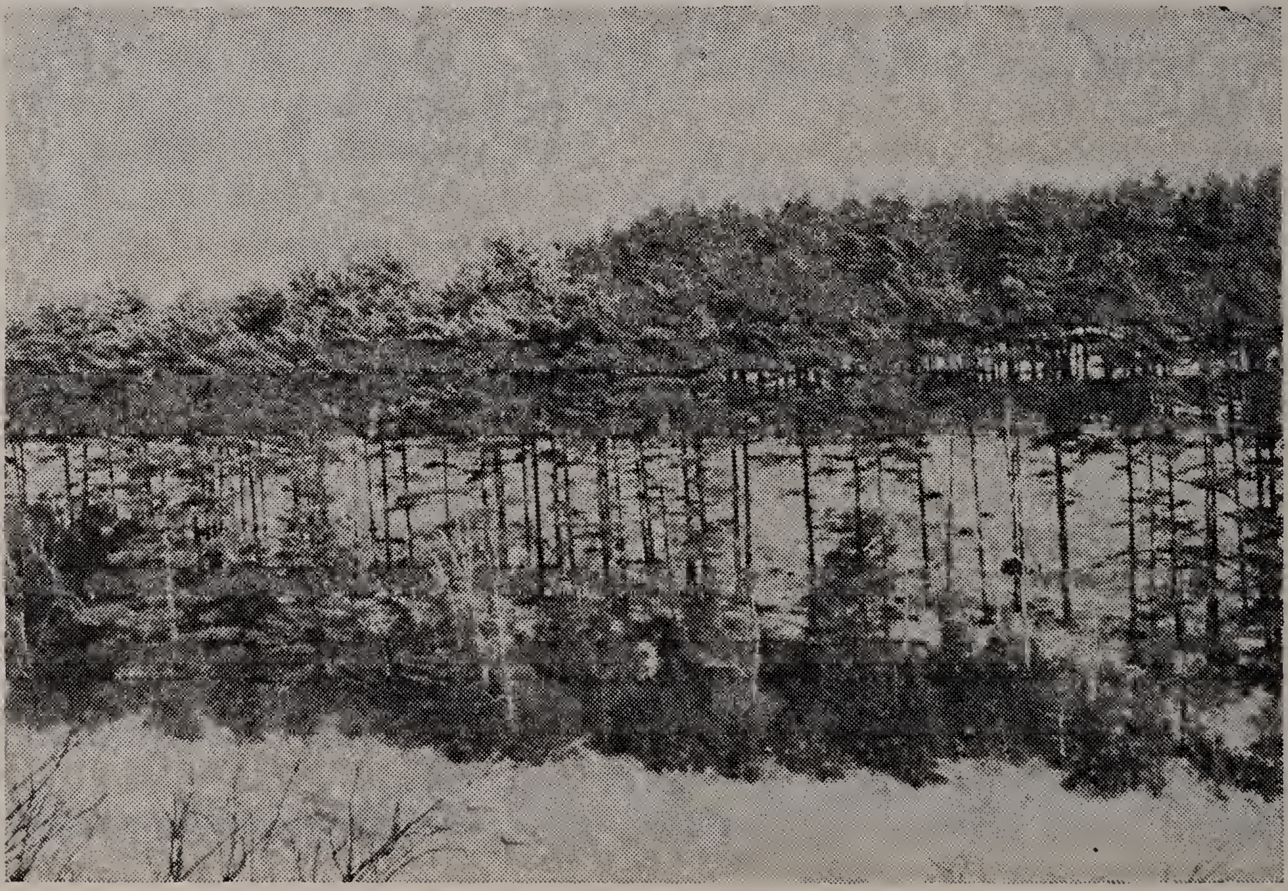

Fig. 7. White pine along the Nashwaak River, New Brunswick. Because of the demand for white pine few stands of this quality remain.

somewhat by the relatively large bodies of water that occupy almost half the District and tend to prolong the growing season. Sugar maple, beech, hemlock and red spruce are found on the zonal sites; tolerant hardwoods occur in pure stands on ridges. Basswood and butternut are found along the Saint John River; red oak, bur oak, silver maple and red ash, along the River and near the lakes. The excellent quality of the white pine on the lighter soils is illustrated in Fig. 7.

The flat, ill-drained tableland of the Central Lowlands forms the border of the District on the north and south, while a series of moist upland flats form a border on the east. The soils are mainly heavy clay loams derived from shales, sandstones, siltstone and conglomerate (Stobbe, 1940). In many places they have weathered deeply, and the slopes are highly productive. Sands, gravels and recent sandy alluvium are common along the River. Except for the poorly drained lands, most of the District has been settled. Apple orchards are widespread. The spruces and balsam fir are well suited to the ill-drained land, but because of clearing and burning they are not always present. Wire birch and red maple occur as weed species on burned areas and on abandoned farms.

Sussex District: The core of the District is the Kennebecasis — Petitcodiac Valley, protected by hills on the west, south, and east. Fig. 3(d) indicates the dry micro-regional climate. White pine, jack pine, and black spruce dominate on sandy soils. Sugar maple, beech, white pine, hemlock, yellow birch and scattered red spruce are found on slopes that have not been cleared.

The borders of the District are located on the north near the 400-foot contour and on the south near 600 feet. On the east it is bordered by the heavy soils of the Eastern Lowland. The soils of the District include sands, sandy loams, and gravels, some of which are limy (Aalund and Wicklund, 1950). They are derived from Carboniferous sandstones and conglomerates, slightly calcareous slate, shale and conglomerate, and scattered ferromagnesian outcroppings. Most of the District was once cleared for agriculture, but portions are reverting to white spruce. Slightly limy soils could be managed for sugar maple, but pine and spruce are probably the most desirable species.

Hillsborough District: Comprised of rolling land below 500 feet in elevation in central Prince Edward Island and protected by distance from the desiccating winds off the Gulf of St. Lawrence. The water deficiency indicated in Fig. 3(d) distinguishes the climate. Sugar maple and beech with scattered yellow birch predominate on uncleared areas; hemlock and red spruce are limited to lower slopes and moist sites. The characteristic relief pattern is illustrated in Fig. 8.

The District is bounded on the north and west by coniferous forest on less rolling land, swept by continuous light winds and cooler temperatures from the Gulf of St. Lawrence. The soils are mainly loams and sandy loams of high fertility derived from red micaceous sandstones (Whiteside, 1950). Coarser soils derived from sandstone and conglomerate occur in the southeast. White pine is widespread on light soils and, with red pine, should be favoured on abandoned lands of this type. Pure stands of white spruce occur on old fields of heavier texture; this species appears to be well suited to the District, especially in view of its resistance to wind desiccation.

East River — Antigonish District: Formed in a system of valleys and lowlands centered in the Pictou Basin and east in the valley of the East River and the Antigonish Lowland. The climate is warm and dry, as indicated by the temperature and water deficiency charts in Fig. 3. Beech and sugar maple predominate, but white pine, white spruce, and balsam fir are widely distributed. Black spruce is common on poorly drained land.

The boundary of the District is along the 500- to 700-foot contour interval. The soils are clay loams, gravelly clay loams and sandy loams described by Cann and Wicklund (1950). They have been derived mainly from Carboniferous shales, siltstone and conglomerate, but metamorphic and intrusive slates, argillite and volcanics are common in the central part of the District. Much of the land was once cleared, but parts have reverted to white spruce. The first crop of spruce has grown well, but compaction of the soil due to clearing and pasteuring may prove to have been detrimental. There may be some advantage in managing pine on the lighter soils.

LaHave District: Comprises a bowl-shaped depression in the south-central portion of western Nova Scotia. The weather data in Fig. 3 indicate an area of relatively low rainfall and high temperatures. The forest is mainly beech, sugar

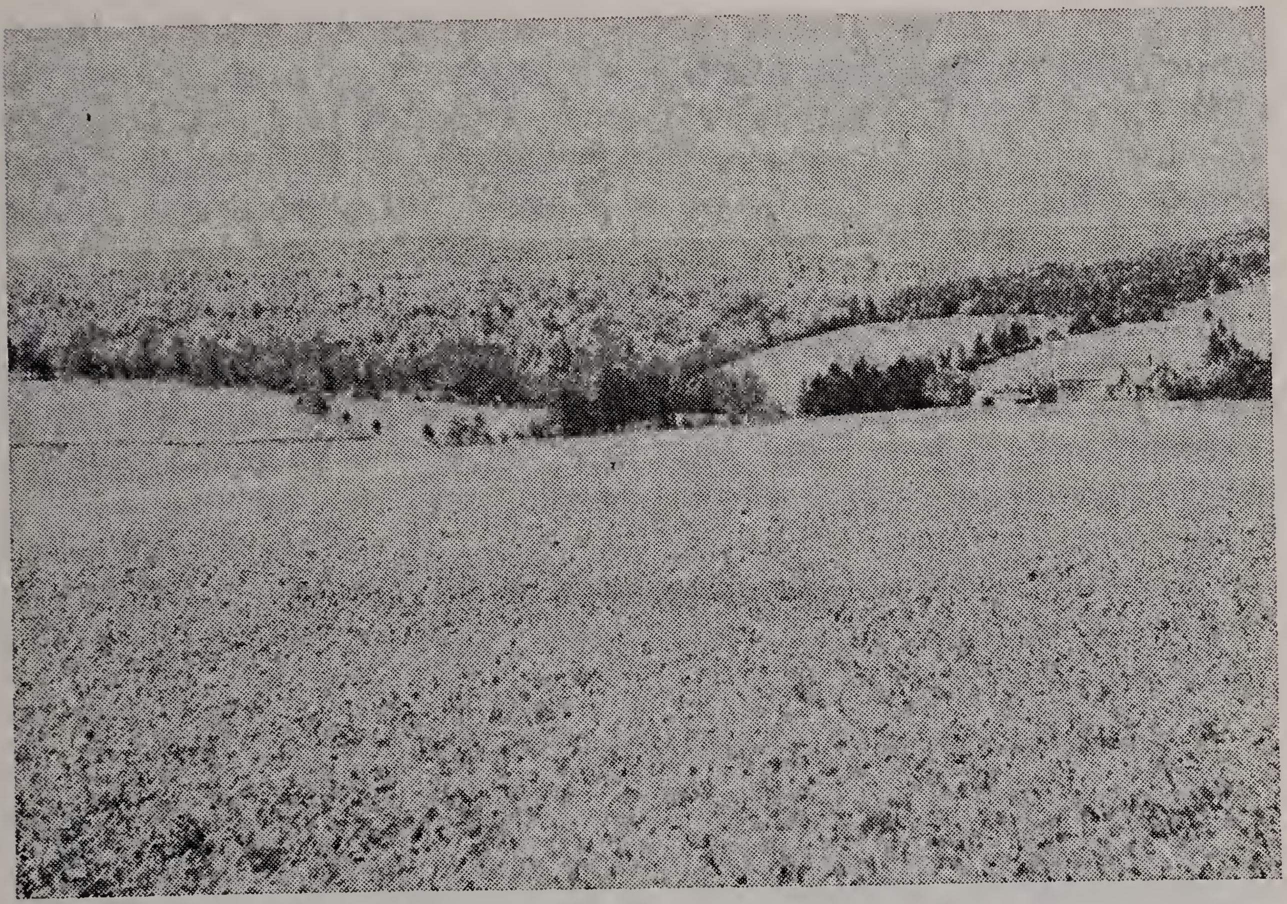

Fig. 8. Rolling forest and agricultural lands in the Hillsborough District, Prince Edward Island. As a rule only the steep slopes with scattered rock outcroppings have been left uncleared.

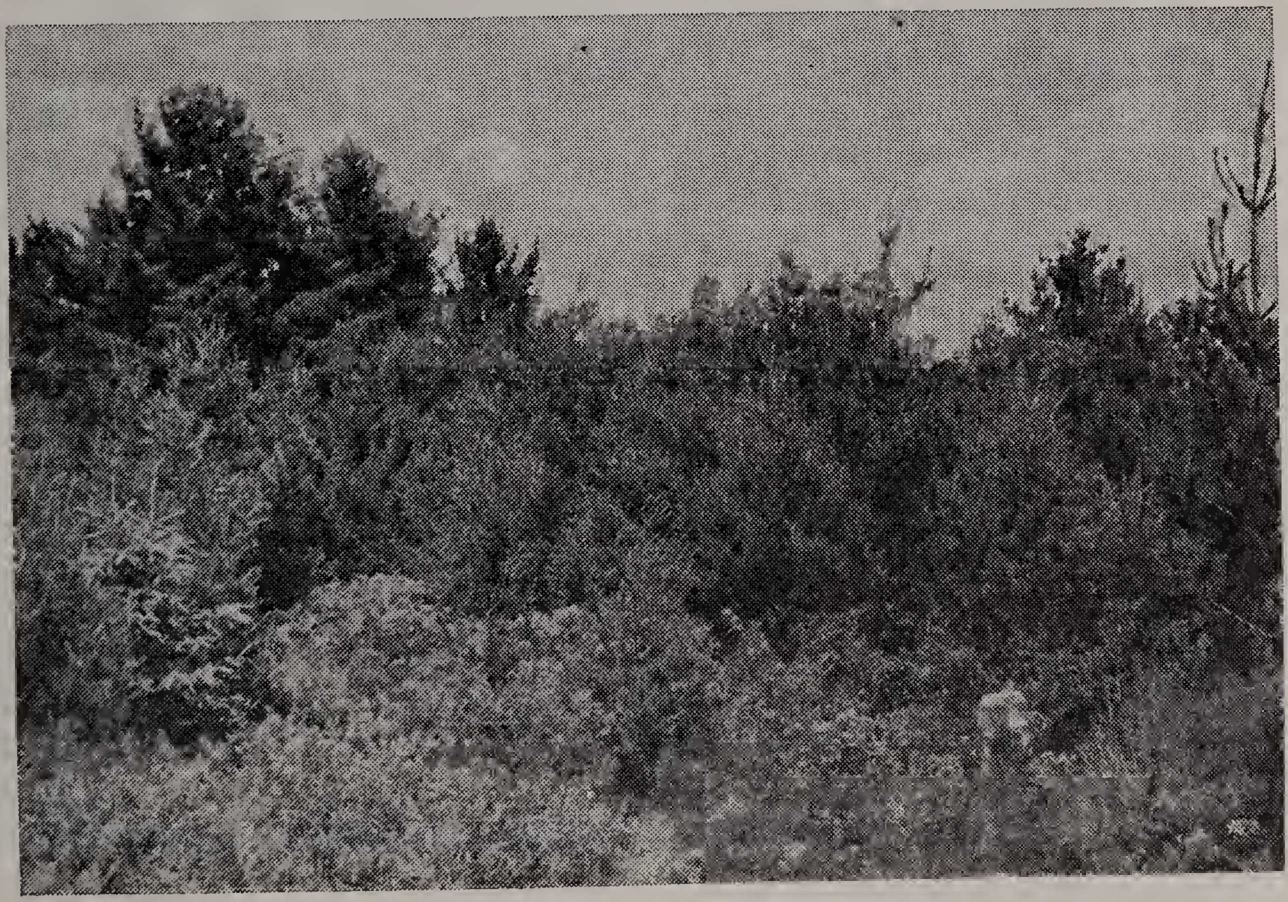

Fig. 9. A pure stand of white pine regenerating on an abandoned field in the LaHave District, southern Nova Scotia.

maple and red oak, with white pine abundant on the lower slopes and valley floors. Black cherry is common, and red spruce and hemlock are found on moist sites and lower slopes. The Lahave valley is one of the few in the Maritime Provinces where white pine forms pure stands on abandoned fields, Fig. 9.

The District is limited mainly to the drumlinized loam soils overlying slate and argillite bedrocks. The surrounding quartzite and granite bedrocks form the higher elevations of adjacent districts. The soils are loams and sandy loams, mostly podsolic rather than podsols, and are generally deep with good drainage. The better soils have been cleared, but some good stands of tolerant hardwood remain. Pine and, in some areas, white spruce and red spruce, appear to be the most desirable species.

Sugar Maple — Yellow Birch — Fir Zone

The zone is distinguished by a predominantly hardwood forest in which yellow birch was formerly large and abundant, This forest is characteristic of relatively high elevations, which, when viewed from a distance on overcast days, frequently may be shrouded in low cloud. Much of the yellow birch has been killed by the outbreak known as 'dieback' (Clark and Barter, 1958), but the forest descriptions that follow refer to conditions prior to such disturbances. The Sugar Maple — Yellow Birch — Fir Zone differs from others in the abundance of yellow birch, white spruce and balsam fir in the hardwood stands, the lack of appreciable hemlock on mixedwood slopes, and the general restriction of white pine to sandy and gravelly soils of the valley bottom. All forests of this type in the Maritime Provinces have been included in the heterogeneous Maritime Uplands Ecoregion.

4. Maritime Uplands Ecoregion

Just as the areas of high elevation in the Maritime Provinces are separated by great distances, so also are the components of this Ecoregion. The hardwood forests on large parts of the uplands are remarkably similar considering the distances separating them. Sugar maple, beech and yellow birch are the most abundant species on the hills, although beech is absent from some of the northern areas. White spruce, red spruce and balsam fir form mixedwoods with sugar maple, yellow birch and red maple on steep slopes. Hemlock is found on ravine slopes in several Districts. Balsam fir, black spruce, white spruce and white pine predominate in the valley bottoms. In a few areas, the higher hills are capped by conifers.

One of the outstanding features is the aggressive nature of the shrub competition in the mixedwood and hardwood stands. Mountain maple, beaked hazel and hobblebush sprout vigorously and grow rapidly on most sites. Hazel has been observed two inches in diameter at breast height and fifteen feet tall. Upwards of 5,000 stems per acre of mountain

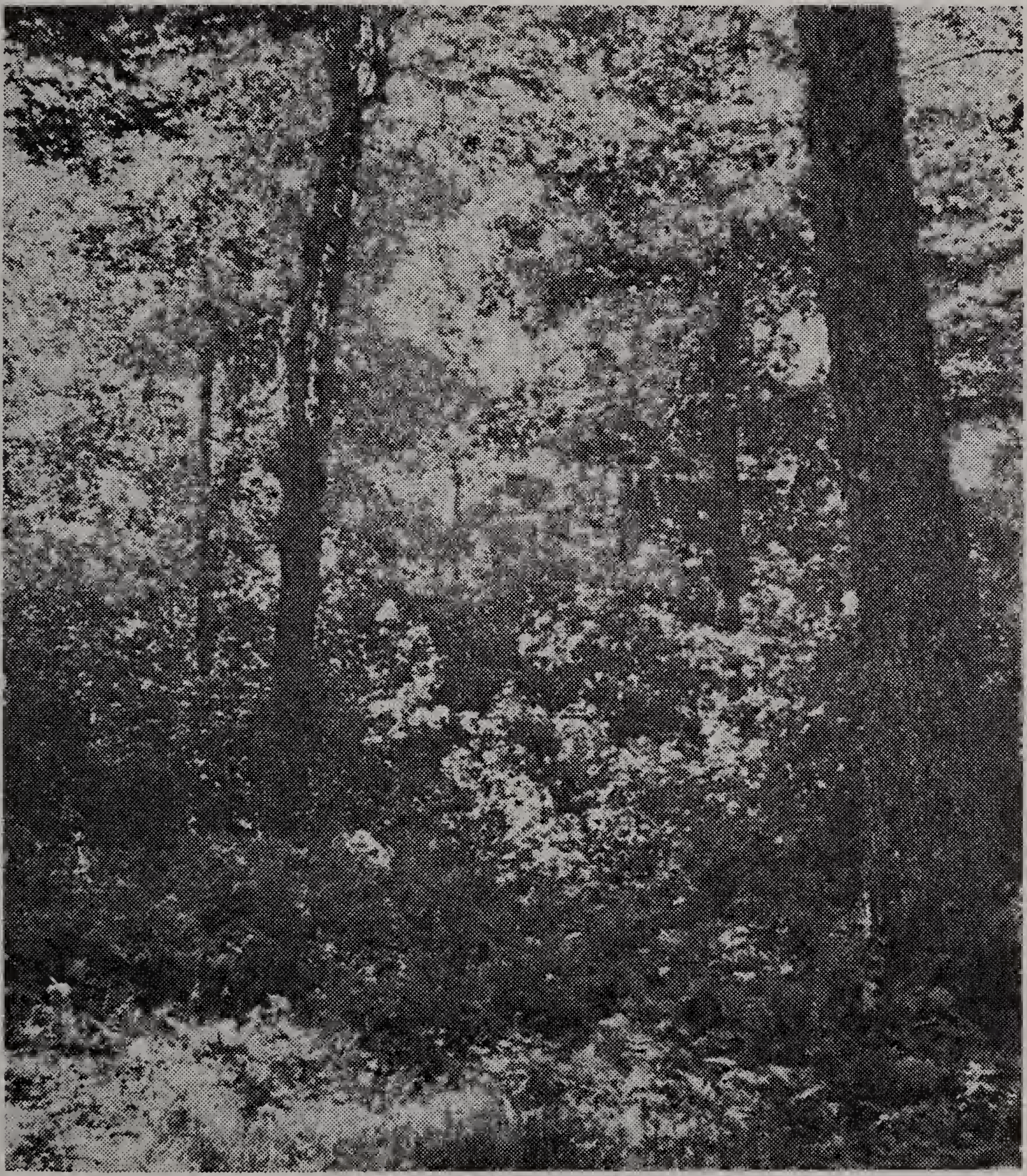

Fig. 10. The luxuriant undergrowth of a yellow birch forest on a moist site in the Maritime Uplands Ecoregion.

maple are not unusual, comprising a basal area of from 20 to 60 square feet per acre. A yellow birch — sugar maple stand with luxuriant undergrowth is illustrated in Fig. 10. Characteristic species of lesser vegetation include wood-sorrel, wood fern, and shining clubmoss, abundant on almost all sites. Zig-zag smilacina, yellow violet and dogtooth-violet are rare. Blueberries (although cultivated in a few areas), sheep laurel. and wintergreen are uncommon in most districts.

Most of the silvicultural problems centre on the shrub competition. Spruce and balsam fir logged from mixedwood slopes are replaced by mountain maple, and long periods are required for the release of suppressed seedlings (Vincent, 1956). The suppression of hardwood reproduction by mountain maple for periods of 10 to 15 years has been noted by Drinkwater in Nova Scotia (1957). Methods of shrub control such as those described by Jarvis (1956) would encourage yellow birch, white spruce and sugar maple on the hardwood sites.

Climatic data for the Ecoregion are sparse. However, records for Summit Depot and Kedgwick, in northwestern New Brunswick indicate the high precipitation and low summer temperatures plotted in Fig. 3. None of the other uplands are distinguished in the charts, but the data are not available. Rain and fog are observed regularly on these uplands when no precipitation occurs on the surrounding lowlands.

Despite the prevalence of hardwood forests with luxuriant broadleaf undergrowth, most of the soils are podsols with a broadleaf mor humus. In many places the leached layer under sugar maple is more than two inches deep. Moderately deep melanization is found in some of the Districts in Nova Scotia, but it is usually associated with local depressions. The soils are mostly fertile, stony loams and silt loams of moderate depth.

Glazier Lake District: The Maine — New Brunswick Highlands, frequently rising to 1,500 feet with deep intervening valleys, form the core of this District. The general elevations are high enough to obtain cooler temperatures and greater precipitation than in the adjacent Edmundston District. Mixed forests of sugar maple, yellow birch, red spruce, white spruce, and balsam fir prevail on upper slopes and most hilltops. Spruce, fir, red maple and the birches are found on the slopes. White pine is common on sandy valley bottoms, and trembling aspen occurs in stands originating after fire.

The borders of the District coincide with elevations between 800 and 1,000 feet. The soils are mainly stony, silt loams derived from slate, argillite and sandstone. Some of the bedrock is resistant to weathering and shallow soils with rock outcroppings can be found. The rough topography contributes to difficulty in logging operations.

Gounamitz District: The strongly rolling approach to the New Brunswick — Gaspé Upland in northwestern New Brunswick makes up this District. Sugar maple, beech and yellow birch dominate the hilltops; balsam fir, white spruce and black spruce form coniferous stands in the valley bottoms.

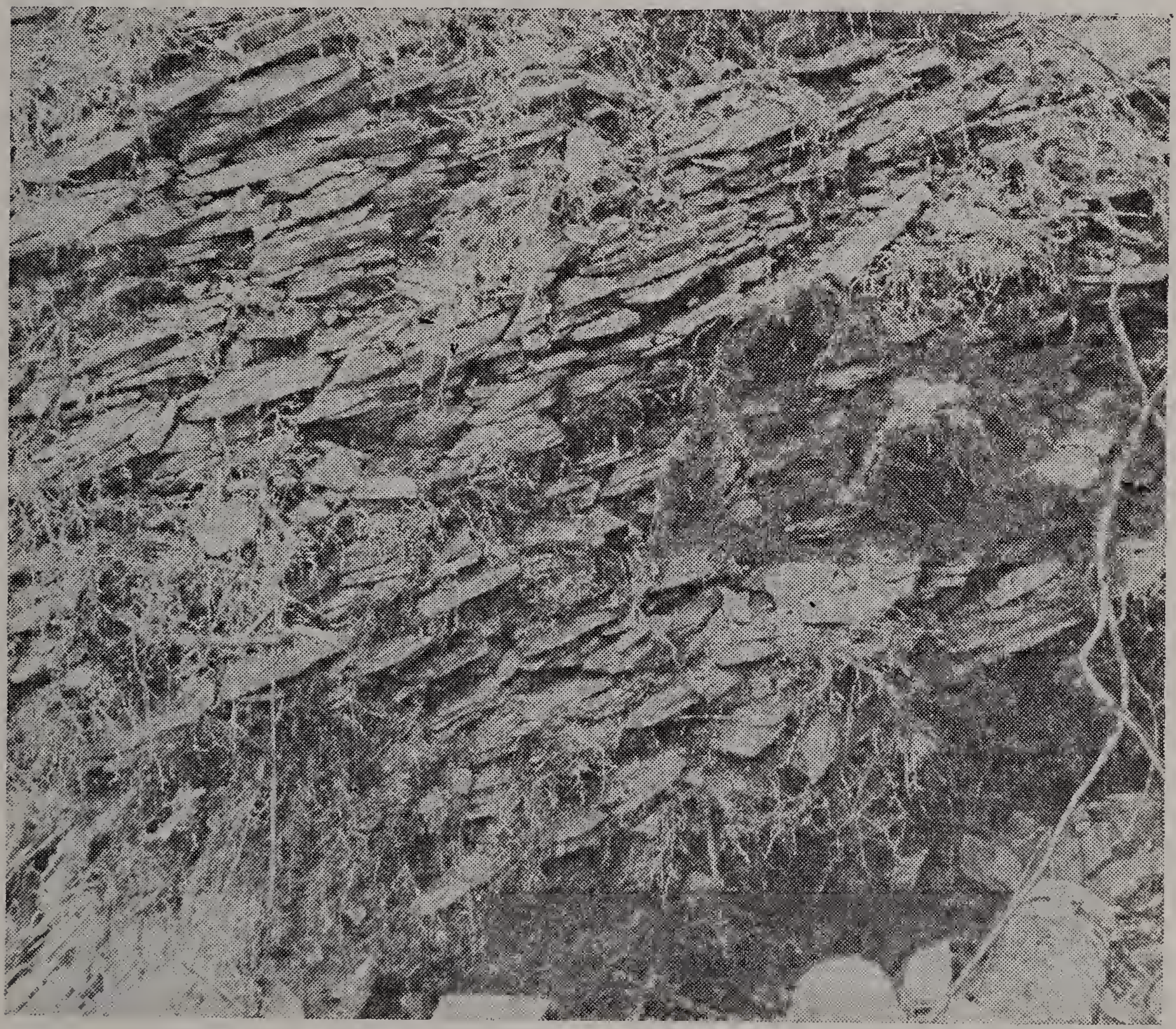

Fig. 11. Deeply fissured argillite bedrock turned up by a wind-thrown sugar maple. The size and number of roots illustrates the deep rooting on the shallow soils in the Gounamitz District.

Mixed stands of balsam fir, yellow birch, white spruce, red maple and white birch occupy the long slopes. Red spruce is found locally.

Coniferous forests at high elevations limit the District on the north while on the south it is bordered by relief generally less than 1,000 feet above sea level. The topography to the east is somewhat less rugged. The soils are rubbly silt loams derived from soft slates and argillites with a deep vertical cleavage. Bedrock is often near the surface, but so fractured that it is readily penetrated by tree roots, Fig. 11. The land rises and falls sharply so that swamps are uncommon. Little of the District has been cleared and stands of fire origin are infrequent. The soft bedrock permits general accessibility for forest operations.

St. Quentin District: The broad, somewhat dissected plateau making up this District divides the Restigouche, Upsalquitch, and Saint John Rivers. Only locally does it rise above 1,500 feet in elevation, but precipitation is high. Sugar maple and yellow birch are abundant; the maple is reported to be free of stain on limy soils. Lower slopes and glaciofluvial flats are mainly coniferous, and formerly supported white pine.

The District is limited on the south and north by lower elevations and a drier climate; more rugged relief borders it on the east and west. The soils are derived from soft slates, shales and argillites. They are loamy and commonly contain calcareous fragments, a feature which distinguishes this District from much of the Gounamitz District to the west. Coarse, rubbly tills are found locally on lower slopes and swamps are more common than in the last District. Portions have been cleared, and large areas have been burned in recent dry years. Yellow birch, white spruce and sugar maple are the most suitable species for rolling upland areas; pine, balsam fir and the white and black spruces are to be preferred in valleys. Red spruce occurs occasionally and may do well on particular sites.

Gulquac — Rocky Brook District: Distinguished by strongly rolling to mountainous highlands, rising 1,500 to 2,000 feet above sea level and separated by deep, broad valleys. The District forms the height of land between the Upsalquitch, Saint John and Miramichi Rivers, and is relatively cool and moist. Sugar maple, yellow birch, balsam fir and red spruce, with the occasional stand of beech, are characteristic of the hilltops. The tendency for spruce and fir to cap the higher hills, with sugar maple on the middle slopes is illustrated in Fig. 12. The valley stands are mainly balsam fir and spruce with scattered white pine. Quality red spruce is an important component on mixedwood slopes in the south. Large cedar are common in the swamps.

The District is bordered on the west and south by lower elevations and on the east by a mainly coniferous forest on higher land. The soils are coarse sandy-loams derived from granite, gabbro, quartzite, argillite and schist; bare bedrock and granite boulder pavements occur locally.

Napadogan District: Occupies the broad southern approach to the New Brunswick Highlands and covers much of the height of land between the Saint John and Miramichi Rivers. Elevations range from 800 to 1,800 feet above sea level. High precipitation and cool temperatures result. Sugar maple and yellow birch, generally of good quality, are abundant. Beech is common on exposed sites. A few red spruce, white spruce and balsam fir occur with the hardwoods on hill-

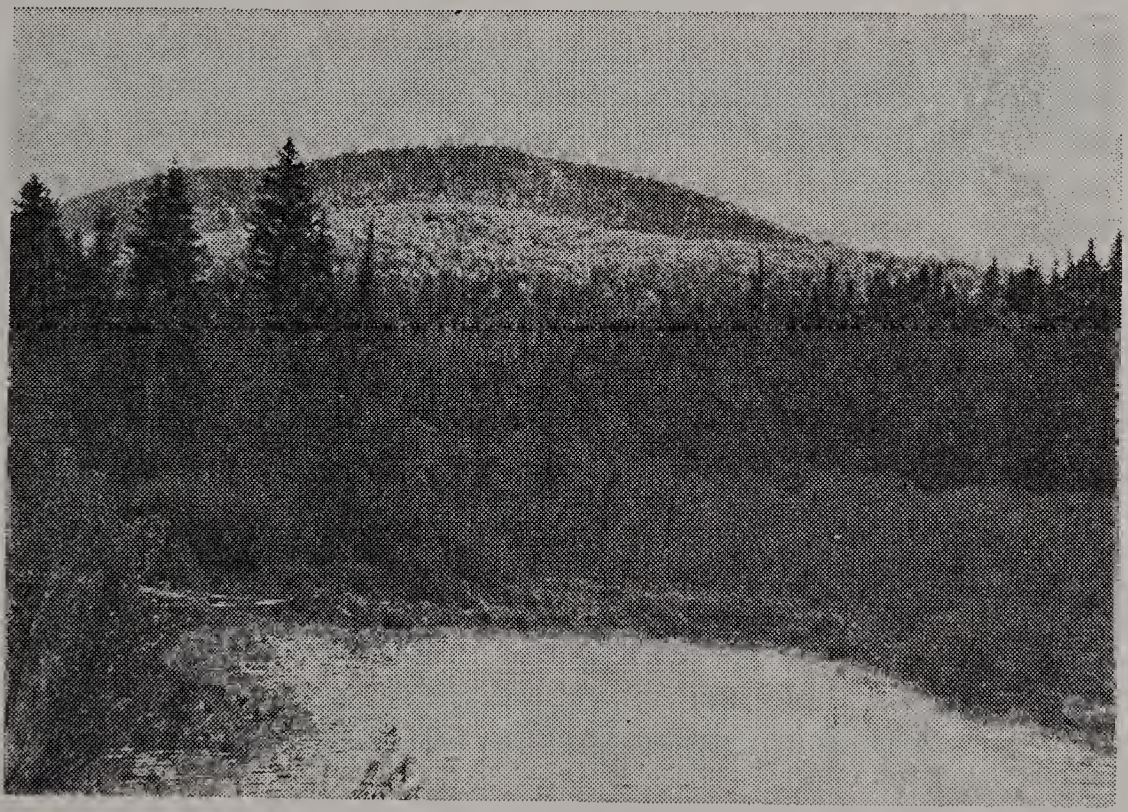

Fig. 12. Tolerant hardwood stands may be found on the low hills and middle slopes, rather than on the hilltops, in the higher land near the border of the Fir—Pine—Birch Zone.

tops and slopes, but form softwood stands with hemlock and scattered white pine on lower slopes and flats. Swamps support cedar, black spruce, red spruce and balsam fir.

Lower elevations border the District on the west, south, and east. The more rugged terrain with a greater prevalence of softwood forest forms a transition on the north. The slate, quartzite, schist, argillite and granite bedrocks have weathered irregularly to form broken topography. Calcareous fragments are found in some soils; others are granitic. The soils are mainly sandy loams, usually deep, but bedrock exposures are common on the higher hills. The District has produced quality sugar maple, yellow birch, red spruce and white spruce for many years, especially on the slightly limy soils. However, a number of silvicultural problems make the re-establishment of these species difficult.

Lepreau — Kierstead District: Kierstead Mountain and the Kingston and Belle Isle Ridges, which rise 600 to 800 feet above a lowland plain, form the core of this District. Included is an area west of the Saint John River, where the low, rugged terrain supports a similar forest. Because of the high humidity, the small difference in elevation appears to be enough to increase precipitation appreciably and to lower the temperature. Sugar maple, yellow birch, red spruce, balsam fir, beech, red maple, white spruce and hemlock occur in various mixtures on the steep slopes and upland flats. Predominantly tolerant hardwood stands are confined to dry, exposed sites. Poorly drained lands with red spruce, black spruce, balsam fir and red maple are common in the western portion.

The District is largely bordered by lower elevations; on the southwest a coastal forest without hemlock or pine occurs. The shores of the Saint John River, where it passes through the District, are related to the Grand Lake District, but they have not been distinguished on the map. The upland of hard volcanic and altered metamorphic rocks is overlain in places by raised Carboniferous sandstones, conglomerates, and limestones. Granite is common in the western part. The resulting soils include clays, clay loams, and sandy loams depending on the prevailing bedrock. The heavy soils are associated with the sedimentary bedrocks and igneous extrusives; the coarser soils overlie granites and are frequently shallow. Some of the District has been cleared, but the farms are reverting to white spruce and balsam fir.

Fundy Mountain District: Consists of a broad upland on the north side of the Bay of Fundy, rising to 1,400 feet above sea level. Although somewhat influenced by the climate of the Bay of Fundy, most of the effects of fog are limited to the lower elevations in the Spruce — Fir Coast Zone. Hilltops on the rolling land above 700 to 800 feet in elevation support mainly tolerant hardwoods, especially on the north slope of the upland. Mixedwood stands of yellow birch and balsam fir are found on gentle slopes and upland flats. Red spruce and white spruce are distributed throughout, but hemlock is limited to steep slopes away from the Bay of Fundy.

The District is bordered by the 600- to 800-foot contour level on all sides. The bedrock of granite, gabbro, and volcanics forms an oval tableland dissected by deep, narrow valleys. The soils are chiefly loams and sandy loams, moderately rich mineralogically. In many places the till is three feet or more in depth, but elsewhere it may barely cover the bedrock. Much of the District was cleared during the early settlement of New Brunswick and then abandoned. Now, most of this land has reverted to a coniferous forest of balsam fir, red spruce and white spruce. As the tolerant hardwoods seldom obtain satisfactory height growth, the District is probably best suited to conifers.

Cobequid Mountain District: Consists of the flat-topped upland in Nova Scotia known as the Cobequid Mountains, rising in places to 1,200 feet above sea level. Although the west end of these mountains is strongly influenced by the climate of the Bay of Fundy, and grades into the colder, wetter Spruce — Fir Coast Zone, most of the District is only moderately cool and moist. Flat portions of the upland with poor air drainage are boreal in character, but adjacent low ridges support short-boled beech and sugar maple, with yellow birch, fir, red spruce and white spruce. Hemlock is common in ravines along the steep slopes of the upland.

The 400- to 600-foot contour interval limits the District on all sides except the west where the Spruce — Fir Coast Zone rises to about 700 feet above sea level. The granitic, sedimentary, and volcanic complex of bedrocks comprising the upland have produced sandy loam soils of great variety (Wicklund and Smith, 1948). Those derived from the ferro-magnesian intrusives are richer than soils formed from sandstones. Seepage sites are common. In spite of the steep slopes, the soils are relatively deep and are productive where not exposed to excessive desiccation from wind. Part of the plateau was once cleared and is now used for blueberries. Exposure to wind affects a large part of the District and susceptible species such as red spruce and yellow birch will be stunted unless protected by a wind-tolerant one. Although access to the plateau is difficult, much of the land is gently rolling, and difficult logging operations are restricted to the mountain slopes.

Musquodoboit Hills District: The core of the District is a range of hills, beginning with the Rawdon Hills on the west, and extending easterly on both sides of the Musquodoboit River Valley to the ridge overlooking the West St. Mary's River. These hills are far enough inland to be away from the cold summer temperatures of the Atlantic Coast, and are high enough to produce the local climates that encourage tolerant hardwoods. Red spruce, white spruce, balsam fir and hemlock cover the upland flats, lower slopes, and valleys.

For the most part, the District borders follow the 500-foot contour. The bedrock includes quartzite, argillite and granite, overlain locally by sedimentary beds. The soils are mainly sandy loams, with heavier textures near the lowlands. Shallow soils and outcroppings of bedrock are common. Yellow birch, white spruce and red spruce appear to be well suited for intensive management, but the birch will be short.

Pictou Uplands District: Composed of the forests on the high land of the Pictou — Antigonish Highlands. The District is also removed from the direct effects of the Atlantic, but elevations are high enough to give abundant precipitation and cool temperatures. Yellow birch, sugar maple and beech are common in the mainly tolerant hardwood forest. Red spruce, white spruce, hemlock and balsam fir are scattered on the upland flats, and form coniferous stands on the lower slopes and valley bottoms. Red spruce is sparse ln the east side of the District.

Lower elevations border the District on all sides. The hard igneous and metamorphic rocks have produced rich, sandy loams of moderate depth. Some of the bedrock has a strong cleavage that permits deep rooting and good drainage. Deeply melanized soils are common locally; bare bedrock is rare. The rolling topography affords more protection from wind for the managment of yellow birch and red spruce than is available in some of the other Districts. Access to the higher elevations is difficult and broad uplands are not extensive. Pure stands of white spruce have been established on abandoned farmlands.

Cape Breton Hills District: Comprised of a series of hills and uplands mainly above 500 feet in elevation and extending from Canso Strait northward in an approach to the Cape Breton Plateau. The climate is largely determined by air masses moving in from the Gulf of St. Lawrence; the moderate elevations obtain moisture and temperature relationships comparable to those prevailing throughout the Ecoregion. Sugar maple, beech, yellow birch and red maple occupy the upper slopes and high ridges; balsam fir, white spruce, hemlock, and intermittently, red spruce, cover the upland flats and ravine slopes. The luxuriant hardwood forest of the Grand Anse valley in northern Cape Breton Island is illustrated in Fig. 13.

Higher elevations distinguish the District from the slightly warmer and drier Guysborough — Bras d'Or District on the south and east. The 1,000- to 1,100-foot contour interval marks the border with the coniferous Fir — Pine — Birch Zone to the north and east. A narrow coastal strip along the west is exposed and somewhat drier than most of the District, but it is not shown separately on the map. Hard igneous and metamorphic bedrocks predominate, locally overlain by sedimentaries. Sandy loam and loam soils have been derived; most are moderately deep, but shallow soils occur on ridges and steep slopes. Seepage sites are common on the slopes. Yellow birch, and occasionally sugar maple, may develop satisfactorily in the protection of deep valleys. White spruce and balsam fir are probably most suited to sites on hilltops and valley bottom flats.

Red Spruce — Hemlock — Pine Zone

This Zone combines the two Ecoregions in the Maritime Provinces in which red spruce and hemlock attain their greatest prominence. One includes most of the interior of western

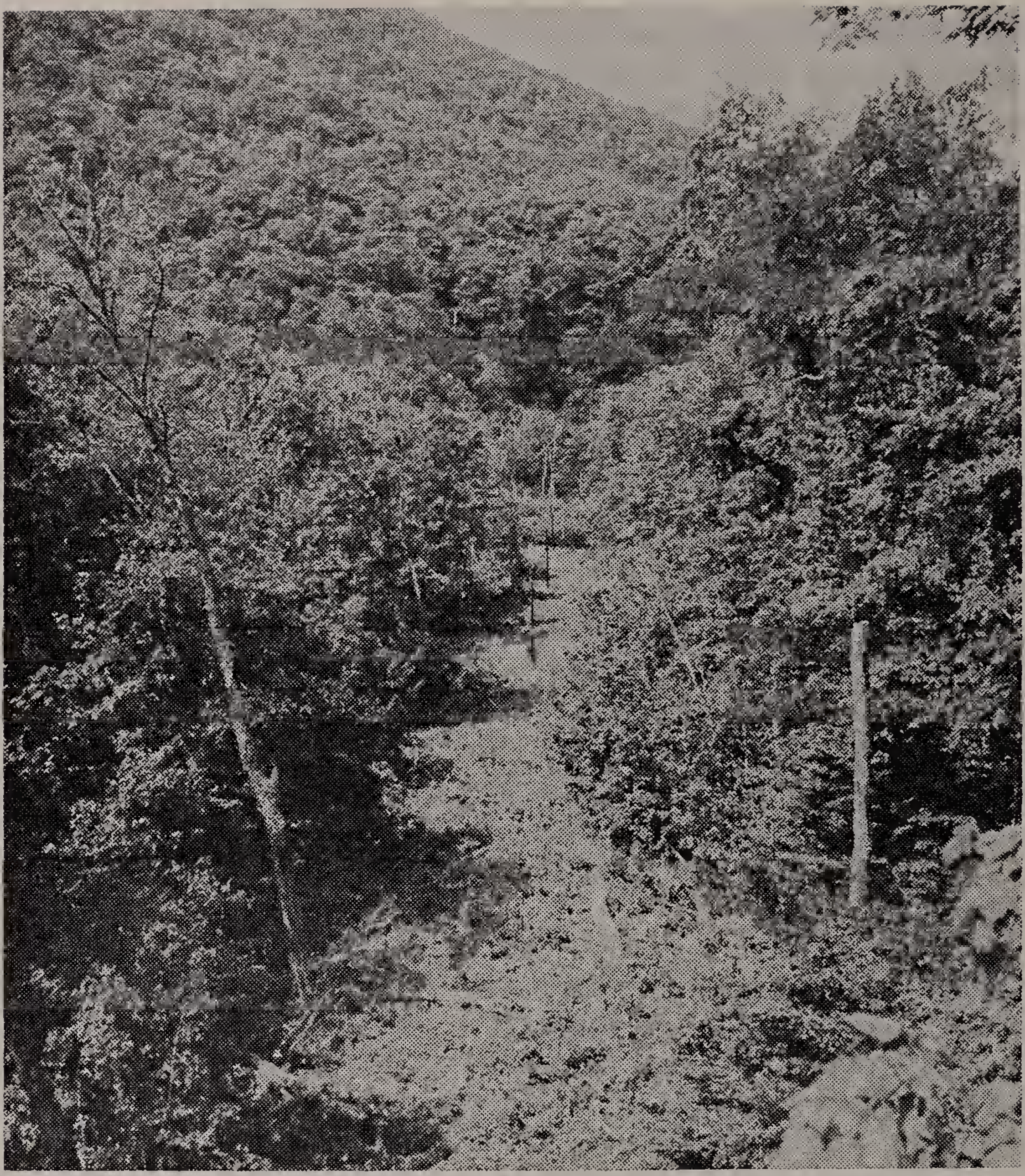

Fig. 13. A luxuriant hardwood forest in the Grand Anse valley of northern Cape Breton Island.

Nova Scotia, where red oak is a common associate; the other occupies much of the lowland of central Nova Scotia and eastern New Brunswick. Heavy soils and imperfect drainage prevail in the latter Ecoregion; sandy, generally shallow soils in the former. Red spruce and hemlock have been depleted in both, but remnants of old-growth forest indicate the former importance of these two species. It is the forests of this zone which, more than any other, represent a distinctive forest in the Maritime Provinces.

5. Clyde River — Halifax Ecoregion

An association of red spruce, hemlock, white pine, balsam fir and red maple, interspersed with red oak, distinguishes the interior of western Nova Scotia from the eastern and central portions of the Province, and from the coastal periphery. Fire has played a prominent role in the destruction of much of the former forest. But white pine, red spruce, and locally hemlock, are found under the red oak and red maple, suggesting a return to a mainly coniferous forest. Early records (Smith, 1801) indicate that beech was formerly abundant on the ridges and that rock barrens were common. Beech is still found on the ridges in some areas, but may have been depleted by the fires. Red oak, red maple, and white birch are now abundant. Excellent stands of old-growth red spruce and hemlock, illustrated in Fig. 14, remain on those portions of the Ecoregion that have not been burned. These occasionally suffer seriously from hurricanes and gale force winds (Johnson, 1955).

Much of this Ecoregion is distinguished by what Roland (1944) refers to as a "Southwestern Flora". He indicates a total of 75 species that occur either only in this area and in southern New England, or are found locally in other parts of eastern Canada but are more abundant in this part of Nova Scotia. Characteristic species include highbush blueberry, inkberry and greenbrier. Witch-hazel is abundant in red oak stands. Fire appears to have been responsible for extensive barrens in the southwestern part, now covered by sheep laurel, blueberry, bearberry, witherod and black huckleberry.

Two problems in forest management of the Ecoregion are the frequent wind damage from hurricanes and the high hazard of fire. Hurricane winds may be expected at almost any season of the year, and are a threat to all classes of forest. In spite of the relatively high precipitation, fire appears to have been common from earliest times. Reporting on a summer of systematic traverses through western Nova Scotia, Titus Smith (1801) repeatedly draws attention to the fire barrens, extensive burned forest, and the large areas of windfall which he attributed to hurricanes. Shrub competition is intense on some of the so-called fire barrens, and conversion to full stocking will be difficult. Regeneration of red spruce, black spruce and balsam fir is usually good following partial

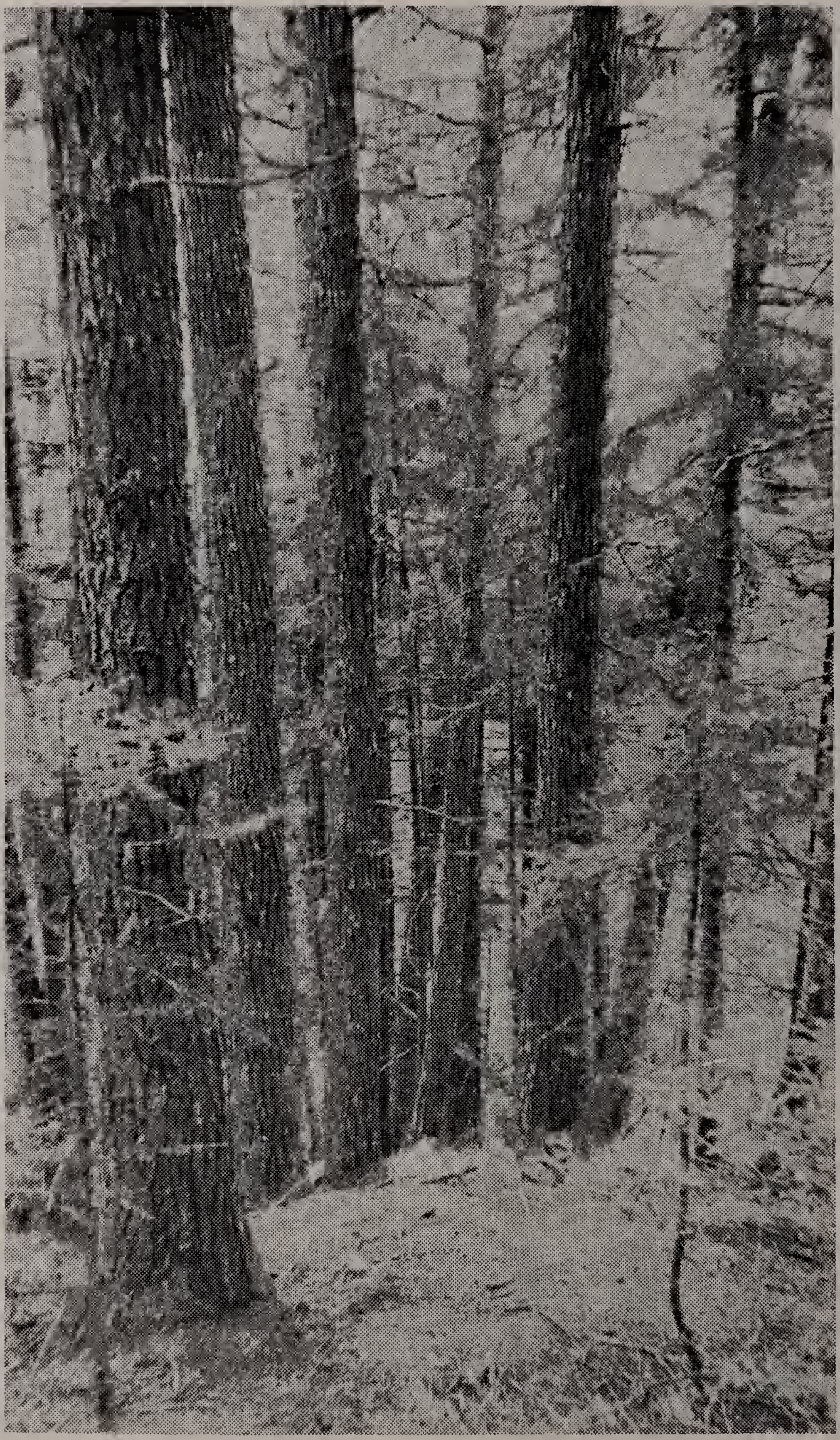

Fig. 14. Eastern hemlock on the lower slope of South Mountain, Annapolis District. Photo by M. H. Drinkwater.

cutting of the mature softwood, but may be lacking on clear cuts. Hemlock and white pine are more scattered. Because much of the oak is not of good quality, conifers should be favoured on these lands.

The outstanding feature of the climate is the high potential evapotranspiration, Fig. 3(c), mapped as a Mesothermal Climate (Thornthwaite, 1948). This reflects the low latitude and warm temperatures, which in other parts of Canada support tolerant hardwoods. Beech, sugar maple and red oak are found on the higher ridges, but the high precipitation appears to favour spruce and hemlock. Although there are few stations that indicate a water deficiency, precipitation is least during the summer months and droughts are common.

Granites, slates and argillite predominate, and the soils range from coarse, loamy sand to loams. A stony till supporting oak and pine is illustrated in Fig. 15. Boulder-strewn,

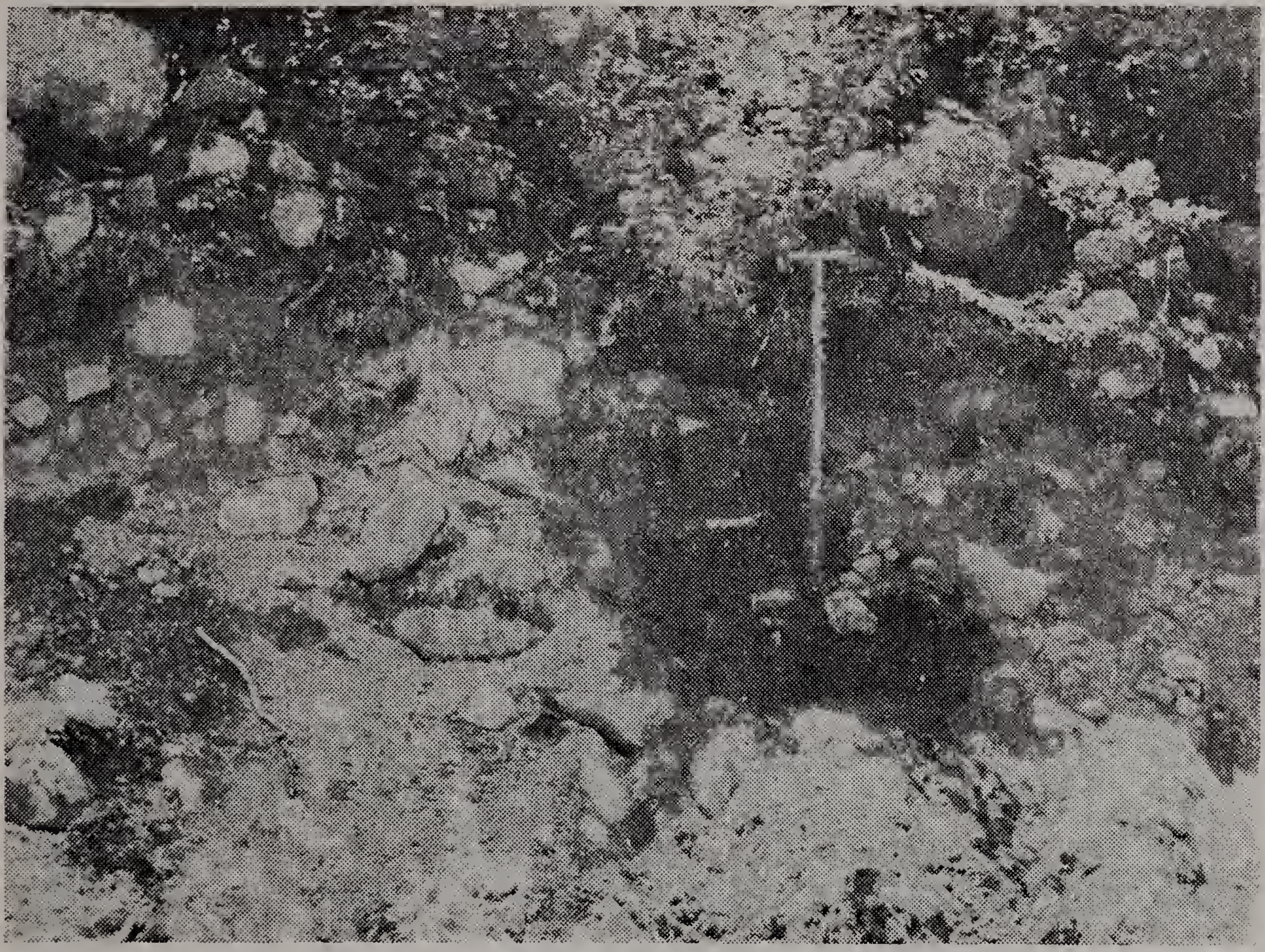

Fig. 15. The coarse, bouldery loamy sand characteristic of much of the Atlantic Upland in Nova Scotia. This site supports red maple, white pine, red oak and white birch of fire origin, but red spruce, black spruce and hemlock are likely to follow.

bedrock plains and poorly drained soils are common. Many of the coarse soils tend to form a pan in the lower B horizons when exposed to drying, but serious deterioration of the soils has not been observed under forested conditions.

Clyde River District: Situated in the most southerly portion of Nova Scotia that is not directly affected by the cold and fog of the Atlantic Ocean. The growing season is hot and droughty on the shallow soils, in spite of the relatively high precipitation. The warm climate is indicated by the presence of plants that otherwise occur no further north than southern Maine (Roland, 1944). The natural vegetation over much of the District appears to have been white pine and red oak, but repeated burning has reduced many of the former pine sites to a shrub cover of three-tooth cinquefoil, bearberry, and broom-crowberry. Sand plains supporting low shrubs and scattered black spruce are shown in Fig. 16. The unstocked, boulder-covered terrain, now dominated by shrubs, may never have supported pine. Black spruce predominates on ill-drained lands; red oak covers the ridges. Hemlock and red spruce are found in the few unburned areas.

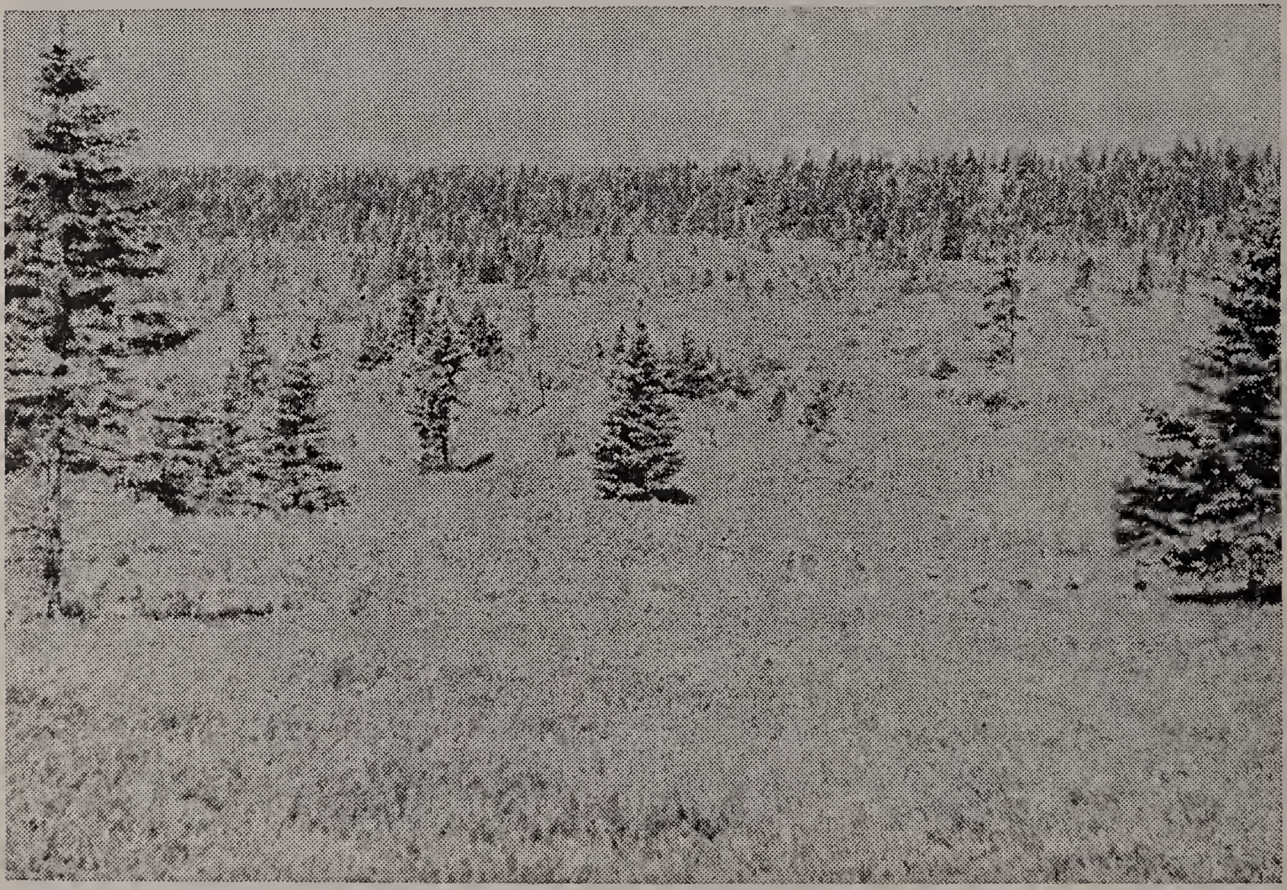

Fig. 16. Sandy barrens in the Clyde River District, southwestern Nova Scotia. Black spruce is regenerating slowly, but it is not so well suited to the sandy soil as is pine.

The cold, moist climate of the Spruce — Fir Coast Zone borders the District on the south, 10 to 12 miles in from the coastal headlands. The border is marked by the absence of red spruce and white pine. The Mersey River District to the east is less extensively burned and has few barrens, while on the west the Wentworth Lake District supports more tolerant hardwoods. The soils are mainly coarse, bouldery, sandy loams and loamy sands derived from granite, quartzite and argillite. Shallow soils and bare bedrock are common, as are glacio-fluvial outwash plains. Reforestation of the sand-plain barrens would be desirable, but planting on the stony, shallow-till barrens will be difficult due to the absence of humus and the intense shrub competition. Some of these lands are burned frequently to culture blueberries, a profitable crop on the poor soils.

Mersey River District: Located in a broad band between the cool Spruce — Fir Coast Zone along the Atlantic, and the warm, relatively dry, Sugar Maple — Hemlock —Pine Zone of the Lahave Valley. Due to the proximity of the Atlantic, temperatures are lower and the precipitation somewhat higher in this District than in much of the Ecoregion. The resulting forest is almost entirely coniferous—red spruce, hemlock, white and red pine, black spruce, balsam fir, and scattered white birch and red maple. Although fires are common, they do not appear to have been so widespread as in the other Districts.

The absence of red spruce and hemlock limits the District on the south, while the tolerant hardwoods of the Lahave District form the north border. The soils are mainly sandy loams derived from slate, schist, granite and quartzite, with exposed bedrock common in many places. An important feature in the forest management is the relative absence of extensive red oak and red maple found in the other Districts.

Fisher Lake — Halifax District: Comprised of the broad, granitic portion of the Atlantic Upland, extending in a long arc from west of Lake Rossignol to Halifax. White pine, red spruce and hemlock are the common species on zonal sites that have not been burned. Beech, sugar maple and red oak are found on exposed slopes and hilltops, particularly around lakes. Fire stands of red oak, red maple and white birch, often mixed with white pine and black spruce, are abundant. Balsam fir and black spruce dominate on ill-drained lands.

The District is bordered on almost all sides by lower elevations, somewhat deeper soils and more abundant tolerant hardwood. A cool, moist climate with less oak is found on the east. The soils are mostly shallow, loamy sands derived from the underlying granites. In view of the infertile soils, and the poor quality of the broadleaf species that have followed fire, the pines probably should be favoured. Red spruce and balsam fir may or may not regenerate following removal of the coniferous stands. Although the District is relatively flat, the shallow soil, hard bedrock, and extensive swamps and lakes make for difficult logging.

Wentworth Lake District: An extensively drumlinized area of hardwoods mixed with red spruce and hemlock, between the cold west coast of Nova Scotia and the granitic Atlantic Uplands. Precipitation is relatively low, as indicated by data for Digby and Saulnierville. According to the local inhabitants, the cool summer temperatures found along the coast do not prevail inland. As the precipitation does not increase inland as rapidly as the temperature increases, somewhat larger water shortages may develop in this District than in the previous three. Sugar maple, beech, red spruce and yellow birch predominate on the hills; red spruce, hemlock, balsam fir, red maple and yellow birch on the lower slopes. Swamp stands are composed of black spruce, fir, and locally white cedar.

The cool summer temperatures of the Spruce — Fir Coast Zone border the District on the west; the higher land, shallow soils, and a mainly coniferous forest border it on the east. The soils are loams and sandy loams derived from slates, schist, quartzite and granite. Most of them are deep in the form of rolling drumlins, but shallow soils overlying slates and granites are found locally. On deep soils the tolerant hardwoods are of good quality, while red spruce and white and red pine appear to do well on all sites.

Annapolis District: The trough between the North Mountain escarpment and the Atlantic Uplands makes up the core of this District. High summer temperatures prevail because of the protection by North Mountain from the low temperatures of the Bay of Fundy. The sites used for apple orchards are on the rich tills of the valley slopes; the dry, sandy soils of the valley floor are more prone to drought and frost.

Sugar maple, beech, red spruce and hemlock are characteristic of zonal sites, while tolerant hardwoods with scattered red oak prevail on dry, exposed locations. Red pine, white pine and red oak are found on the valley bottom sand plain. Tree distributions in the valley have been discussed in detail by Roland (1946).

North Mountain forms one boundary of the District; the shallow soils and coniferous forests of the Fisher Lake — Halifax District form the other. The soils are deep red sands and sandy loams (Harlow and Whiteside, 1943), well-drained where there is moderate relief. They have been derived mainly from the underlying soft, red Triassic sandstones. Shallow coarse tills derived from granites occur locally on the western slopes of South Mountain, and loams derived from slate and shale are found on the eastern portion. Although the District is thickly settled, parts are being allowed to revert to forest. Red and white pine should be favoured to replace wire birch on sandy soils; red spruce and red oak are well-suited to the better sites.

6. Maritime Lowlands Ecoregion

Red spruce, black spruce, balsam fir, red maple, hemlock and white pine comprise a distinctive forest association on the gentle relief of the lowlands in all three Maritime Provinces. Jack pine is abundant on sandy soils, and black spruce swamps and peat bogs cover extensive areas. Red maple and wire birch, rather than red oak, predominate as fire types. Beech often forms pure stands on exposed ridges, with scattered spruce and fir, but sugar maple and yellow birch may be found on the larger hills.

The lesser vegetation of this Ecoregion reflects the generally poor drainage and repeated cutting and burning. Witherod and rhodora are the common shrubs in areas of repeated disturbance; in places they may so effectively control a site that they exclude the softwood regeneration. Sheep laurel, mountain-holly and speckled alder are other aggressors. Common smaller plants include wintergreen, gold-thread, naked miterwort, bunchberry, bristly clubmoss, sphagnum and Schreber's moss. Mountain maple, wood fern and wood-sorrel are present, but not as abundant as in the more humid Ecoregions. The relatively clean forest floor under white pine, spruce, fir and cedar on a moderately well-drained loam is illustrated in Fig. 17.

Problems in the silviculture of this Ecoregion lie in the conversion of wire birch and shrub-covered waste lands to suitable softwood species and in the establishment of a suitable pine on the sandy soils where jack pine once predominated. Black spruce regenerates on these sites, but does not grow as well as the pines. Nickerson (1956) has suggested that in addition, it may be detrimental to the soil. Most of the land dominated by shrubs is poorly drained, but appears to be a good site for the spruces. Remnants of the oldest stumps on some of these sites have been identified as pine, hemlock and cedar.

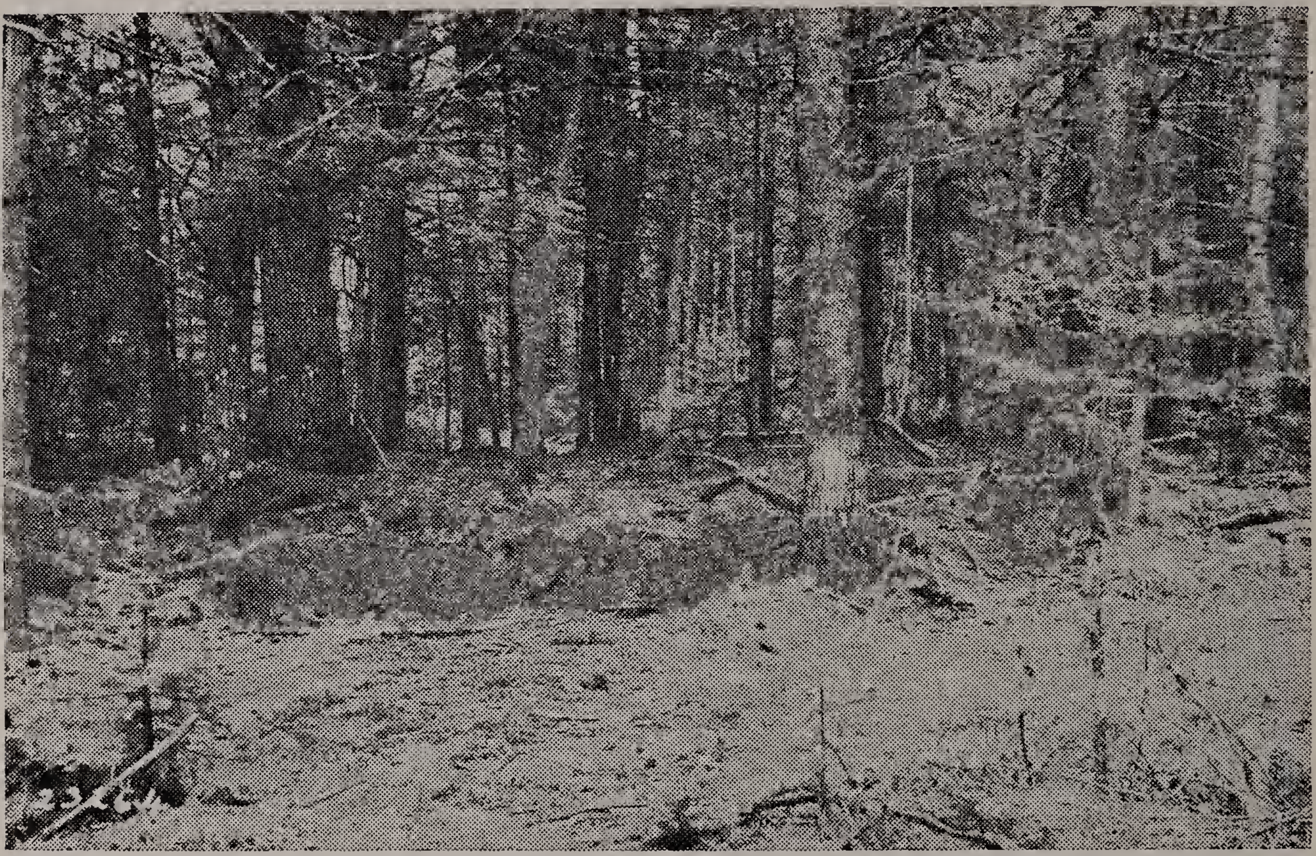

Fig. 17. White pine, hemlock, cedar, spruce and fir on a moderately well-drained site at the Acadia Forest Experiment Station, Maritime Lowland Ecoregion.

The summer precipitation, Fig. 3(a), ranges from 8 to 10 inches with an average summer temperature of from 62 to less than 64 degrees. The precipitation is moderately low, and the temperatures just above average, for the Maritime Provinces. A small water deficiency occurs in many parts.

On the whole, the Ecoregion is slightly cooler than the adjacent Magaguadavic — Hillsborough Ecoregion.

Features that are probably more important than climate are the heavy texture of the soil and the poor drainage. The zonal, well-drained site is rare. Where it occurs, the local climate and species distribution are so influenced by the surrounding swamps and bogs that the forest on the zonal site reflects many characteristics of poorly drained land. It is possible that if lighter soils and more relief were present, this Ecoregion could support extensive stands of tolerant hardwoods, and would then form part of the Sugar Maple — Hemlock — Pine Zone. However, those are not present, and available information indicates that the forest on the zonal sites is sufficiently different from those of other Ecoregions to warrant a separate description.

Oromocto District: Comprised of gently rolling land centered on the Oromocto River in the western end of the New Brunswick Lowlands. Portions of the District are above 400 feet in elevation, but the Oromocto valley is broad and flat. Beech, sugar maple, red spruce, balsam fir and white pine are found on the occasionl exposed ridge. Balsam fir, hemlock, red maple, red spruce and yellow birch prevail on the zonal site. The hemlock and yellow birch are rare on disturbed areas. Poorly drained land with black spruce, red spruce, balsam and cedar is widespread. Red and white pine are common on the lighter soils.

Soils containing calcareous fragments and supporting tolerant hardwood forests border the District on the west, while the coarse soils with pine and hardwood border it on the south. The Saint John Valley surrounds the remainder. The bedrock consists of sedimentary sandstone, siltstone and shale. Stony, red clay-loam soils predominate; they tend to be poorly drained except on steep slopes and where the bedrock is close to the surface. Red sandy loams derived from slightly calcareous sandstone and conglomerate as well as recent sandy alluvial soils occur locally. Much of this District was once settled and extensively cleared and burned. Weed species such as wire birch and alder cover some of this land, but it is reverting slowly to red spruce, white spruce and balsam fir. In the few areas where red pine has become established following fire, the good growth suggests that this tree should be encouraged by planting. For the most part, the topography and soil are not adverse for forest operations.

Nashwaak — Miramichi District: Consists of the strongly dissected portion of the New Brunswick Lowland centered on the Nashwaak and Miramichi Rivers. Tolerant hardwoods occur on the ridges and some of the long steep slopes. However, much of the land is either flat or gently rolling, and balsam fir, red spruce and hemlock with red maple and yellow birch comprise the stable forest on zonal sites. Repeated burning has encouraged jack pine on a wide range of conditions. White pine is common; frequently it forms pure stands on the light soils along the rivers.

Coarse soils and mainly hardwood forests form the western border of the District, while flat, ill-drained land forms the east, and south borders. Stony clay loams and loams derived from sandstone and shale are most wide-spread, but sandy and gravelly soils occur along large rivers. Shallow soils are found in many areas, but bedrock outcroppings are uncommon. The poorly drained sites appear to be well suited to spruce, balsam fir, and in some areas, jack pine. Regeneration following cutting is usually good for all species except jack pine. In a few areas the latter appears to do better than any other tree and it would be a preferred species if methods can be found to regenerate it.

Bantalor District: Consists of the flat, slightly elevated but undissected height of land between the St. John and the Miramichi Rivers. The extremely flat land appears to permit cold surface air to accumulate and a boreal type of forest prevails. Black spruce dominates and barren, raised peat bogs cover large areas. Jack pine, so abundant to the north and east, is rare. Red spruce, black spruce, balsam fir, hemlock, birch and cedar are common species in remnants of stable forest on the moist sites.

More strongly dissected topography forms the boundary of the District on almost all sides. The bedrocks are flat Carboniferous sandstones and mudstones. The heavy, basal till smeared over the bedrock allows little internal drainage. Slopes are therefore moist, and flat hilltops and depressions form swamps, shallow soils and gravels may be well-drained. Fires have been frequent in parts of the District and wire birch, red maple and white birch predominate locally. The prevalence of swamps has probably limited the spread of the fires, but many of the wet lands show evidence of being burned. The poor drainage restricts forest operations to some extent, but a moderately well-drained slope that permits road construction is usually present along streams.

Harcourt District: Consists of the flat lowland plain forming the height of land between the St. John River and Northumberland Strait. Although poorly drained land predominates, a widely distributed surface layer of ponded sand tends to permit seasonal droughtiness. Black spruce swamps and peat bogs are common. Fires have been frequent, and jack pine, with an understory of black spruce and balsam fir, is the common cover type. However, reports of an early tanbark industry indicate that the original forest was well stocked to hemlock. It appears to have grown with red spruce, black spruce, and white pine. Hemlock and red spruce are now rare, except along the streams.

The District is bordered on the north and south by rolling terrain and on the west by the absence of jack pine. The stunting effect of winds from the Northumberland Strait is the limiting factor on the east. The soils are heavy clays and clay loams, often overlain by a shallow layer of fine sand. Some of the clays on low-lying land near the coast are of marine or lacustrine origin. Although hemlock was formerly abundant, jack pine and red pine appear to be well adapted to the seasonally wet land and should be favoured over the slower growing black spruce.

Allardville District: Comprised of a broad, somewhat elevated flat between Miramichi Bay and Chaleur Bay. Most of the District is gently rolling, but a few rivers cut across with deep, narrow valleys. Some of the well-drained ridges support red spruce, hemlock, beech, yellow birch and red maple. Pure stands of jack pine, and jack pine with black spruce, red spruce and balsam fir predominate on the older burned land. Repeated recent burning has reduced portions of the District to pin cherry and white birch. Wire birch is a recent invader.

The District is bordered on the south and west by rolling topography and more abundant hardwood. Wind effects from the Gulf of St. Lawrence extend inland five to eight miles along the north and east. The soils are clays, sandy clays and sandy loams, most of them shallow, the lighter soils being on the ridges. They are derived from the underlying sandstones, siltstone and shale. Red spruce appears to do well on deep soils that have not been burned. Jack pine and black spruce are of good quality on sandy, ill-drained uplands; balsam fir is reported to be inferior.

Petitcodiac District: The portion of the rolling Petitcodiac River valley covered by heavy clay-loam soils forms the core of this District. Local geological uplifts have tilted many of the sedimentary bedrock strata, and several ranges of low hills occur. Tolerant hardwoods are found on the exposed sites, but hemlock, yellow birch, red spruce, black spruce, fir, pine and the occasional sugar maple and beech prevail on the slopes and lower ridges. Repeated cutting and burning have spread jack pine, black spruce, wire birch, red maple and white birch over much of the District.

Tolerant hardwoods and better drained soils form the southern and western boundaries of the District. Flat, ill-drained sites border it on the north, and coastal effects on the east. The soils are mainly red clays and clay loams, but sandy loams derived from conglomerates and sandstones occur locally. Much of the District has been settled and a patchwork of forest and agricultural lands prevails.

Northumberland Shore District: Comprised of a five to 20-mile wide belt of coastal forest along the Northumberland Strait from Chaleur Bay to Pictou on the mainland, and from North Point to west of Summerside on Prince Edward Island. Open-grown trees in the District lean away from the direction of the wind; their crowns are usually one-sided and damaged. Second growth stands appear unusually short unless there is a taller old-growth forest in the area to act as a shelterbelt. Winds from Chaleur Bay and the Northumberland Strait dominate the north, central and eastern portions. Coastal fog and winds from the Bay of Fundy influence the central portion. Average summer wind speeds along the coast are almost double those of inland stations (Brougher and Thomas, 1948). Black spruce, jack pine, white spruce, red spruce and red maple are the most abundant species, although hemlock and white pine are not uncommon. Prior to the repeated burnings, red spruce, hemlock, and white pine were probably more abundant. Tamarack occurs with black spruce on the extensive bog land. Beech and sugar maple are found on a few slopes near the larger streams.

The border of the District follows a line where winds from the Gulf of St. Lawrence appear to be unimportant in the establishment and growth of new stands. On Prince Edward Island the border also follows the edge of the heavy soils. Most of the soils are the clays and loams derived from red sandstones and shales or from lacustrine materials. Red sandy loams with slightly better drainage are more common in the east. Repeated fires have encouraged jack pine, and on many sites it appears to be better suited to the soil and climate than red spruce. Red spruce suffers particularly from exposure to the wind. White spruce is to be preferred over jack pine as a wind resistant species for sites along the coast-line and for shelter-belts.

Prince Edward Shore District: Mainly well-drained, light, sandy soils along the north shore of Prince Edward Island distinguish this District. The prevailing climate and exposure to wind is similar to that of the last District. However, jack pine is rare, and red spruce and hemlock are less common. White spruce, black spruce, balsam fir, red maple and the occasional white pine are characteristic species. Beech and sugar maple may be found on ridges near the Hillsborough District.

The District is bordered on the west by heavy soils and by tolerant hardwoods on the south. The soils are almost entirely sandy loams derived from fine micaceous sandstones and siltstone. Sand dunes and bars are found along the coast. Species suited to the District include white spruce, balsam fir and black spruce. White spruce has reforested much of the abandoned farm lands, and it is to be preferred over other species for its faster growth. Black spruce and scattered tamarack prevail on ill-drained and peaty sites.

Oxford District: Consists[1] of rolling land between the Cobequid Mountains and the Northumberland Strait. Geological lifting and tilting combined with stream dissection have produced high rolling hills. Sugar maple, beech and yellow birch are common on the upper slopes, but red spruce, balsam fir, black spruce and hemlock are found on upland flats as well as middle and lower slopes. Jack pine, aspen, spruce and wire birch are abundant after fire on lowland flats.

The District is bounded by the steep slopes of the Cobequid Mountains on the south, and by coastal effects on the other sides. The soils are variable and include, clay loams derived from sandstone and shale, sandy loams from hard sandstone and conglomerate, as well as sands and gravels along the river courses (Whiteside, *et al.*, 1945). Most of the District has been either cleared or burned. Sites presently supporting red maple, white birch and trembling aspen are better suited to the red spruce and white spruce that are gradually increasing. Softwoods have not always restocked the abandoned farm land in this District as they have in much of Nova Scotia, and the spruces and pines may have to be favoured by planting.

Windsor — Truro District: Comprised of a lowland surrounding Cobequid Bay in Nova Scotia, and extending from the Cobequid Mountains to the Annapolis Valley. Scattered sugar maple, beech and yellow birch occur locally on the low ridges, but the spruces, fir, white birch, red maple, hemlock and white pine form a relatively stable forest on zonal sites. The clearing and abandoning of farm land has allowed pure stands of white spruce and balsam fir to be established in many areas; repeated burning has encouraged wire birch, white pine, red pine and black spruce in others. Black spruce flats and swamps are common in the west. White elm, black ash, and occasionally sugar maple and beech, may be found along the river systems.

Higher land and lighter soils border this District on all sides. The soils are mainly red clays derived from shale and sandstone, but sandy loams are found on the ridges in some areas (Cann, *et al.*, 1954). Alluvial and lacustrine soils are common along the rivers. Red spruce, white spruce and red pine appear to be well suited to all but the wettest sites. Much of the central part of the District is under agriculture.

St. Mary's River District: Centered on the somewhat elevated sedimentary bedrocks that form the Truro — Guysborough trough. The mainly flat, ill-drained topography favours balsam fir, white pine, red spruce and hemlock on zonal sites where tolerant hardwoods are found in Districts to the north and south. White pine, red maple and black spruce are scattered on the extensive barren lands where sheep laurel and bracken dominate. The barrens appear to have originated with repeated burning.

Tolerant hardwood forests border the District on all sides except the west, where lower elevations and heavier soils are found. Sandy loams derived from hard quartzose sandstone and conglomerate cover most of the District, but there is considerable variation, especially in depth. Portions of the District that were once cleared have reverted to a mainly coniferous forest. White pine, black spruce, balsam fir and red spruce appear to be the most adaptable species for management.

Sheet Harbour District: Consists of a broad band of low, rugged hills and upland flats on the Atlantic Uplands,

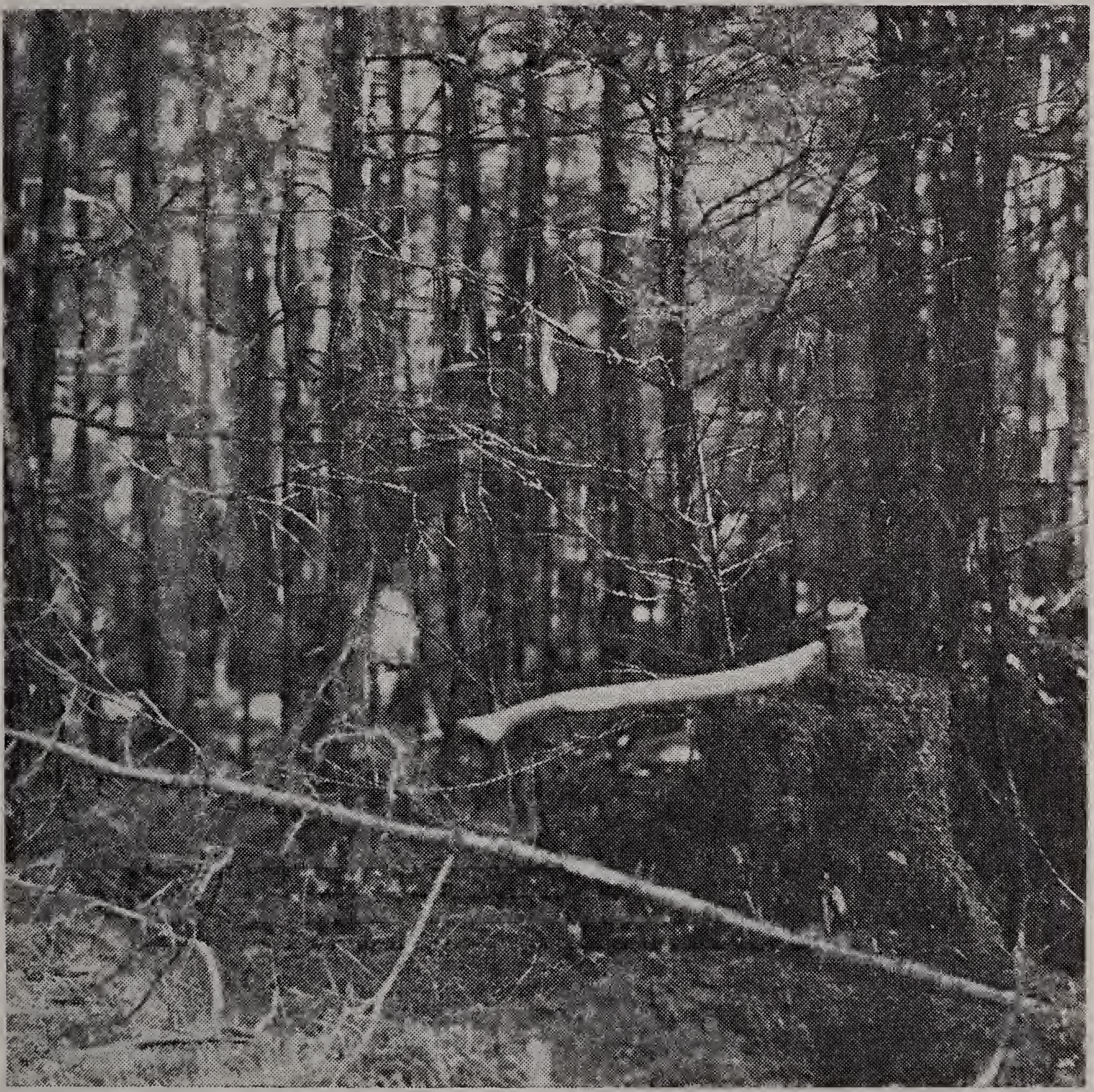

Fig. 18. Dense balsam fir regeneration on an old log cut, Sheet Harbour District. Photo by I.C.M. Place.

east of Halifax. It occupies a position geographically and climatically between the cold, wet Spruce — Fir Coast Zone on the south, and the higher Sugar Maple — Yellow Birch — Fir Zone to the north. Red spruce, balsam fir, yellow birch, hemlock, and white spruce are the common species on well-drained sites, but beech, yellow birch, red maple and sugar maple can be found on the higher hills. Exposed bedrock cliffs commonly support white pine and black spruce. Although somewhat dissimilar from the remainder of the Ecoregion, the District cannot be included elsewhere.

The north border is marked by higher land and more abundant tolerant hardwoods, while on the south, coastal influences form a boundary five to 20 miles inland. The soils are sandy loams of great variability derived from slates, argillites and granites, but deep, rich tills are found, alternating with coarse, shallow tills and bare bedrock. Red spruce, white spruce and balsam fir grow well in most of the District; yellow birch is well suited to deep soils on protected sites. Pine should be favoured on shallow, exposed soils and on talus slopes. Regeneration to conifers is usually good, as illustrated in Fig. 18. The rough topography, hard bedrock, and shallow soils make most of the District difficult for logging.

Spruce — Fir Coast Zone

Two coniferous Ecoregions, one with abundant red spruce and one with no red spruce, comprise a zone of spruce—fir forests along the shores of the Bay of Fundy and the Atlantic Coast of Nova Scotia. Hemlock and white pine are absent. Red maple and white birch are the common hardwoods, although beech and sugar maple occur on a few of the higher hills. Late springs, cold summers and frequent fogs (Putnam, 1952) are the outstanding features of the climate. Where the winds are strong and continuous the trees are short and stunted. However, spruce and fir growth appear to be good on the more protected sites and on the better soils.

7. Fundy Bay Ecoregion

A stable association of red spruce, balsam fir, and red maple, with scattered white spruce, white birch and yellow birch characterizes the zonal site. Beech and sugar maple are found locally on the higher elevations of North Mountain and the Fundy Upland. The mixed nature of the forest is apparent in Fig. 19 where the yellow birch has been damaged by dieback. Hemlock and white pine occur only along the inland border of the Ecoregion. Stands of fire origin are uncommon. Except on North Mountain, red spruce is the common species seeding in on abandoned farmland.

The lesser vegetation is distinguished by a number of species of boreal affinity. Cowberry, or rock cranberry, is common on the dry rocky sites, and cloudberry is found in the peat bogs. Canada raspberry, the boreal variety of the wild red raspberry, is common. Mountain-ash is abundant in most of the Ecoregion and often attains diameters of more than 10 inches.

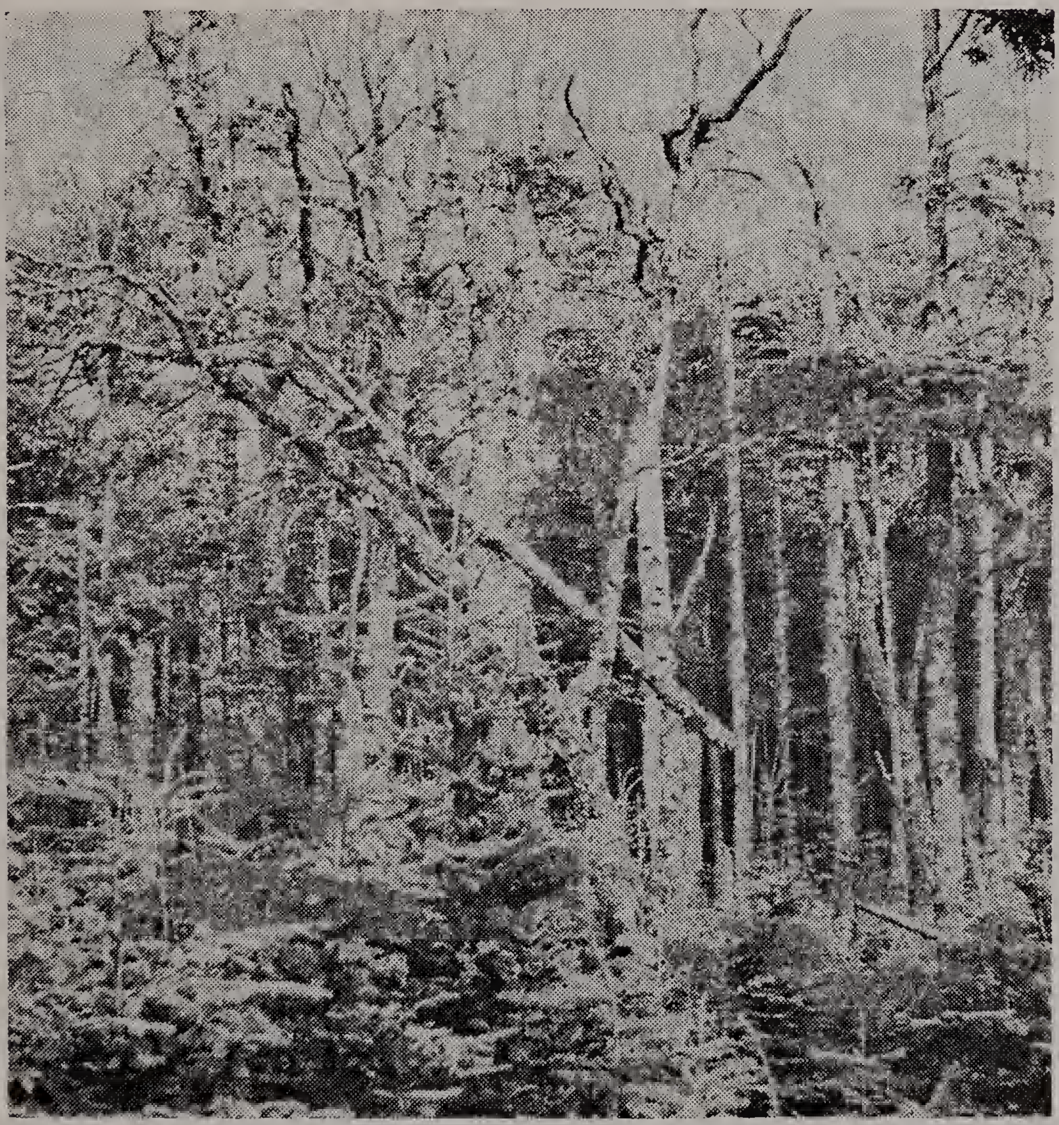

Fig. 19. Decadent yellow birch and balsam fir representative of the Fundy Bay Ecoregion.

The most important deterrent to rapid growth appears to be wind. This is discussed under the Atlantic Shore Ecoregion where it is more severe. Trees on headlands and exposed ridges have a short, broken appearance, even in dense stands. Although damage from salt spray may be important, it does not account for the appearance of the trees on inland ridges. Trees do well in areas near the coast protected from wind, but ridges miles from the direct effect of salt spray look the same as coastal headlands. Shelterbelts of a wind-resistant species such as white spruce have been observed providing effective protection, and should be stressed in the silviculture of the Ecoregion. Shallow soils and extensive bare bedrock will make this difficult. Regeneration of conifers is usually good on the deeper soils, but red maple of sprout origin tends to dominate in a few areas.

The climate is distinguished by the low summer temperatures indicated in Fig. 3(b); they are comparable to those of the northern coniferous portions of New Brunswick. In addition, precipitation is high and fog is frequent. Although the spring warm-up is late, the winters are not as cold as in the interior of New Brunswick and Nova Scotia. Judging from the similarity in climate, the Fundy Bay Ecoregion appears to be well suited to some of Canada's West Coast species.

The soils and underlying bedrocks are particularly variable. Slates, shales, sandstones, and volcanic, hard metamorphic and igneous rocks are found along the New Brunswick coast, while basalt and lava underlie North Mountain. The soils range from coarse sandy loams to clay loams, many of them shallow over the bedrock.

Musquash District: Consists of the low hilly portion of the New Brunswick coast, located mainly on high-base bedrocks along the southwest. The terrain is rough and exposed bedrock is common. Red spruce, white spruce, black spruce, and balsam fir occur on slopes exposed to the Bay of Fundy. Red maple and yellow birch are common with the conifers on protected sites; red maple also forms pure stands in a few areas. White cedar is abundant on a wide range of sites, including the bedrock ridges. The subarctic cloudberry and black crowberry are common in a type of coastal peat bog.

The north border of the District, about ten miles inland, is marked by the presence of white pine, hemlock, and appreciable sugar maple and beech. The soils are shallow, stony, sandy loams derived from granite, gabbro, volcanic rocks, sandstones and, in a few areas, limestone. Much of the District has been heavily cut over and partially cleared, but a coniferous cover has returned in many places. White spruce should be preferred on exposed sites.

Chignecto District: Consists of the northeastern portion of the Ecoregion, much of it adjoining low mountains of the Fundy Uplands and the Cobequid Mountains. Red spruce is more abundant along the coast and in the abandoned fields than in the Musquash District. Balsam fir and white spruce grow with it. Yellow birch, white birch and red maple are scattered, limited mainly to protected sites. Beech may occur locally at high elevations; sugar maple is rare. Almost all the land that is not in use for agriculture is stocked to a dense, predominantly coniferous forest.

The limit of white pine and hemlock, up to ten miles inland, forms the border of the District. However, because extensive clearing was once carried out in the District, the pure

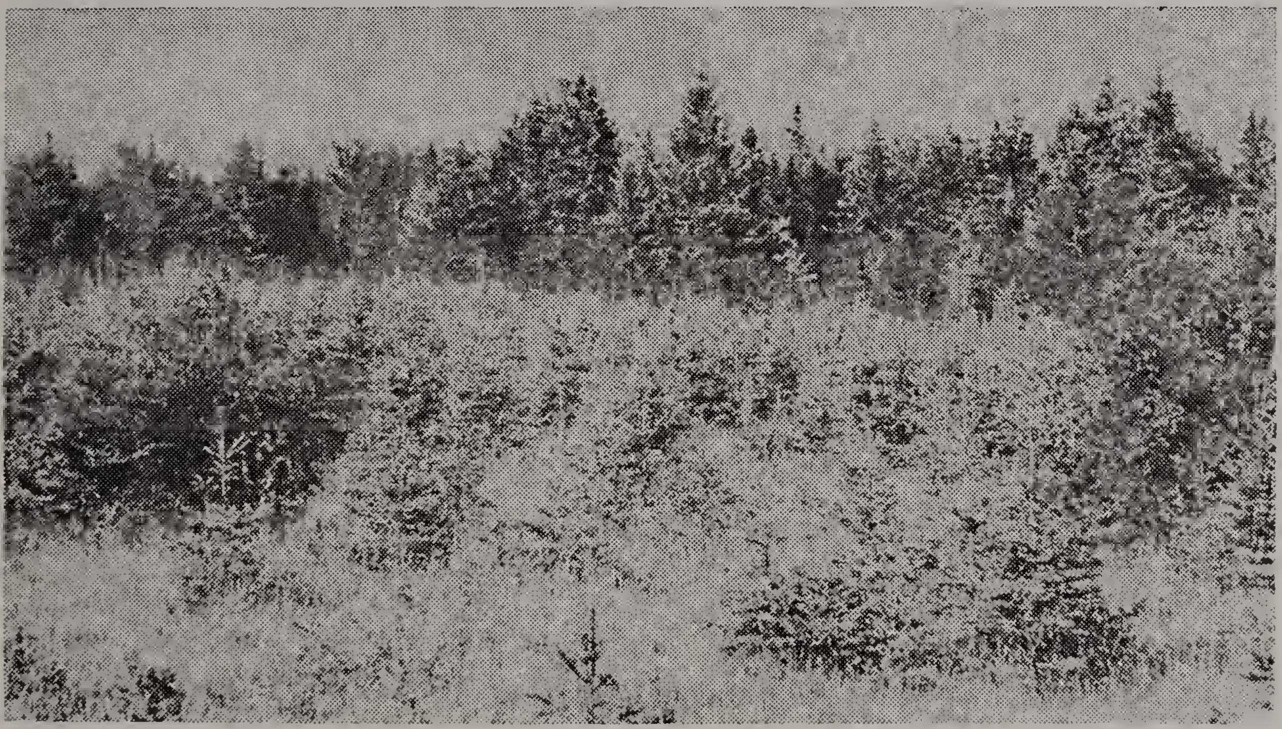

Fig. 20. In many parts of the Maritime Provinces the abandoned fields are quickly stocked to even-aged stands of white spruce. A young stand on recently abandoned land is illustrated in the middle background, and an older stand behind it

stands of red spruce on abandoned land is an equally good boundary feature. White spruce, illustrated in Figure 20, predominates on the abandoned farmland farther inland. The soils include clay loams derived from sandstones, shales and volcanic rocks; marine and estuarine clays around the Bay of Fundy coast; sandy loams derived from sandstones, conglomerate and hard igneous and metamprphic bedrocks, and local deposits of sands and gravels. Although the indigenous species grow moderately well, the climate suggests that several West Coast species could be introduced. Exceptionally good growth has been observed on early Norway spruce plantings. Wind effects are not so pronounced in this District as in the last, but shelterbelts could be used to advantage.

North Mountain District: Consists of the north slope of the Mountain, rising to about 600 feet above sea level. The high elevations of the District form a barrier to the cold air moving off the Bay of Fundy, protecting the Annapolis District Red spruce is only moderately abundant in the stable forest and it is scattered in the softwood stands on abandoned fields. Sugar maple and beech are limited mostly to the higher elevations where they may be above the level of the cold air from the Bay of Fundy. Mountain-ash is common, often exceeding a foot in diameter. The stands on the upper slopes of North Mountain are greatly stunted.

The District is bordered on the south by the abrupt escarpment of North Mountain. The virtual absence of red spruce forms the western boundary. The soils are reddish-brown clay loams derived from trap rock and fine grained sandstone. Some of the soils are shallow, and seepage sites are common. White spruce, red spruce and balsam fir appear to be well suited to the District. With the existing road system, the topography and soil present little difficulty to logging.

8. Atlantic Shore Ecoregion

White spruce, black spruce and balsam fir, predominate in this Ecoregion. Heart-leaf birch is scattered, mixed with the conifers, and red maple and yellow birch are found locally on the better soils. White pine, beech and hemlock may be found along the inland border. Red spruce is absent. Bare bedrock is common, with the result that the stands tend to be open. In areas of eastern Nova Scotia, illustrated in Fig. 21, the fir tends to be dense. Most of the stands are windswept and therefore stunted.

A few boreal species such as mountain-ash, cowberry and Canada raspberry distinguish the lesser vegetation. However, the most prominent feature is the absence of the 'southwestern flora' (Rolland, 1944) from the southern portion of the Ecoregion. Most of the herbaceous species associated with rich tolerant hardwoods are also absent, particularly in the Eastern Shore District.

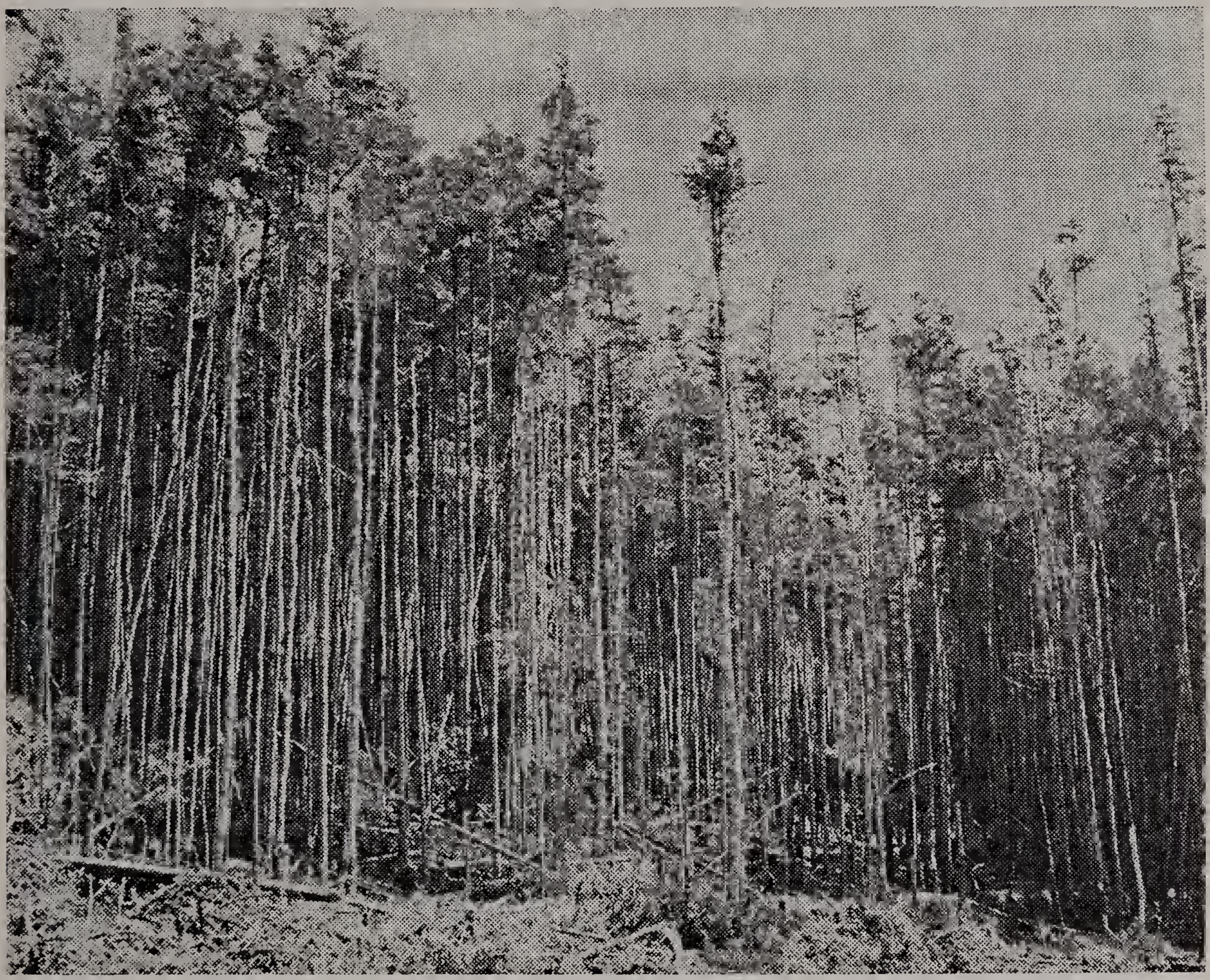

Fig. 21. Dense balsam fir, 40 to 50 years old and three to four inches in diameter, along the south coast of Cape Canso, East Atlantic District.

Silviculture in this Ecoregion will be governed to a considerable extent by efforts to reduce the effects of coastal winds on regeneration and growth. Continuous light winds such as those along the Atlantic Coast appear to increase transpiration loss in some species to the point where growth is restricted. F. H. Whitehead (1957) has discussed the importance of wind in decreasing the rate of dry weight increase, a response which he suggests should be attributed to 'drying out' of the plant. His evidence indicates that conifers are affected in much the same way as herbaceous plants, but that differences between species can be expected. Salt spray may be another factor, but its effects over long distances are questioned. White spruce achieves better form and growth along the coast than either black spruce or balsam fir. Appropriate shelterbelt reservations of a wind and salt resistant species could be expected to improve conditions for seedling establishment and the growth of all species. Regeneration is abundant in areas where there is some forest cover, but non-reproducing sod and shrub barrens are common.

The climate is distinguished by the high precipitation and low summer temperatures indicated in Figs. 3(a) and 3(b). Spring warm-up is slow, but the frost-free period is longer than anywhere else in the Maritimes.

The bedrock underlying the Ecoregion is argillite and slate, with local areas of granite and sandstones. The soils tend to be shallow and coarse textured. Exposed bedrock is common on the ridges and headlands.

Cape Sable District: Consists of a coastal strip extending from Brier Island in western Nova Scotia to Mahone Bay on the south coast. The climate is somewhat warmer than in the Eastern Shore District, but is none the less cool and wet. Most of the original forest along the coast has been either cleared or burned, and white spruce, balsam fir and black spruce are the species becoming established. A dense cover of alder has taken over in some areas, however, and ericaceous shrubs in others.

The District is bounded by the limit of red spruce and white pine This line probably marks the inland limit of the cold and fog prevailing along the coast. The soils are mainly shallow sandy loams alternating with bare bedrock, but deeper soils in the form of drumlins can be found. Drainage is good, considering the high precipitation. White spruce and black spruce are probably the only trees well suited to the rigorous climate. Most of the District is accessible either by water or from coastal roads.

Eastern Shore District: Made up of a band of coastline, five to 25 miles wide, extending from Mahone Bay to the eastern end of Cape Breton Island. Although variations occur along the 250-mile length, there appears to be no justification for recognizing more than one District. The climate, especially during the growing season, is colder than in the Cape Sable District. The abundance of black spruce and balsam fir in comparison to white spruce also distinguishes the District. White spruce prevails along the immediate coast, but is less common inland; it may form nearly pure stands in cleared or disturbed areas. Tamarack is abundant on the flat, ill-drained portions of Cape Breton Island. Fires have been common in part of the District, but they appear to have been started by settlers to extend their pasture land. However, the presence of jack pine in several places on the Canso peninsula, and on Madame Island, suggests that the constant winds may create a droughtiness that is conducive to fire.

The mainland portion of the District is bordered by the limit of red spruce, hemlock and white pine, but on Cape Breton Island where red spruce is uncommon, by the limit of pine and hemlock alone. A few tolerant hardwoods are found in the valley of the Mira River. The soils include heavy clays derived from sandstones and shales on eastern Cape Breton Island, and sandy loams, mainly overlying argillite and granite, in the remainder of the District. Many of the sandy soils are shallow, and where burned or cleared, may remain barren for years. White spruce, black spruce and balsam fir are well suited to the rigorous climate, but their growth is slow and the stems frequently so dense (Fig. 21) that they require a long period to reach merchantable sizes. Much of the District is not accessible, and the small size of the timber makes conventional forest operations unrealistic. In the more protected portions, tree sizes could be increased by using shelterbelts of wind resistant species.

Fir — Pine — Birch Zone

Two types of coniferous forest are included in this Zone. Both have species of southern affinities such as red maple, yellow birch and white pine, but one is a region of high precipitation and few stands of fire origin; the other is drier and has an abundance of species whose distribution is related to repeated fire. A balsam fir, white birch, white spruce, and black spruce assocation is found in both Ecoregions. Yellow birch and red maple (without white pine) are characteristic of one; white birch, white pine, jack pine, aspen and black spruce of the other. Taken as a whole, this Zone forms the transition between the boreal spruce forests to the north and the mainly deciduous forests to the south.

9. New Brunswick Highlands Ecoregion

A predominantly coniferous association of balsam fir, white spruce, black spruce, white birch and white pine characterizes the well drained slopes. Mainly black spruce and balsam fir are found on the low mountains, but these sites are generally exposed and have shallow soils. Red spruce, red maple and yellow birch occur locally and sugar maple may be found in isolated pockets. White pine and jack pine, with black spruce and balsam fir, are found on gravelly soils along the rivers. Aspen, mainly of fire origin, is abundant on slopes to fire-swept valleys. Cedar swamps are scattered and white elm and black ash can be found along the rivers.

The ground vegetation is predominantly boreal, but a large number of sub-boreal species are present along the streams and in the cedar swamps. Mosses predominate, with Schreber's moss most common. Bunchberry, maianthemum, wintergreen, sheep laurel and blueberry are the common herbs and shrubs. Bigleaf aster is abundant under aspen stands. Wood fern, wood-sorrel, and mountain maple, although common, are not as widely distributed as in the Gaspé — Cape Breton Ecoregion.

Regeneration of conifers is usually good; the balsam fir is frequently dense. Because it is the most abundant species, epidemics of the spruce budworm, *Choristoneura fumiferana* (Clem.) are a threat to maturing forests. Much of the young fir can be shown to have originated following destruction of old growth forest by the budworm in the epidemic between 1913 and 1918. Control of such outbreaks by suitable cutting practices (Prebble, 1951) is the primary requirement in the forest management of the Ecoregion. Erosion of steep cut-over slopes and the regeneration of exposed, dry sites are other silvicultural problems. A few burned areas have not reproduced to softwoods, and support scattered birch and aspen.

Although climatic data are not available, most of this Ecoregion corresponds to the Central Highlands Region suggested by Purnam (1940, 1952). Meteorological data from Summit Depot and Kedgwick, although outside the Ecoregion, are probably representative and have been used in drawing the isopleths in Fig. 3. The climate is distinguished by low summer temperatures and a lower rainfall than that of the Gaspé — Cape Breton Ecoregion.

The underlying bedrock is unusually variable. Slates, argillite and schist alternate with volcanic rocks and granite. The soils range from rubbly sandy loams to shallow loamy sands and rock talus. The four Districts are distinguished primarily on differences in their relief, bedrock, and soils.

Kedgwick District: Consists of a broad rugged valley centered on the upper reaches of the Kedgwick River in northwestern New Brunswick It is protected on the west and south by the higher elevation of the Green River District The higher land apparently creates a rain-shadow, for fires are moderately frequent and white pine and aspen are abundant in parts of the District Balsam fir is the dominant tree, but white spruce, black spruce and white birch are common; white pine is scattered except in the fire stands. Red spruce is found mainly at high elevations, and yellow birch more commonly on slopes at low elevations Jack pine is found on the Quebec side of the Patapedia River, and may be expected in New Brunswick.

The limit of white pine is near the 1,500-foot contour and forms the boundary of the District Scattered sugar maple forming the southeast border are illustrated in Fig. 22. The soils on the steep terrain are rubbly sandy loams derived from slate, argillite and sandstone; calcareous fragments are found in a few areas. The deep cleavage of the bedrock promotes drainage and permits deep rooting, even in shallow soils. The spruces and fir regenerate well and are suited to the District. Logging tends to be difficult because of the rugged topography, but the soft bedrock in most of the District permits good roads.

Blue Mountain District: Made up of the band of horizontally stratified metamorphic bedrock between the hard core of the New Brunswick Highlands and the coastal lowlands along Chaleur Bay. Most of the District is rolling,

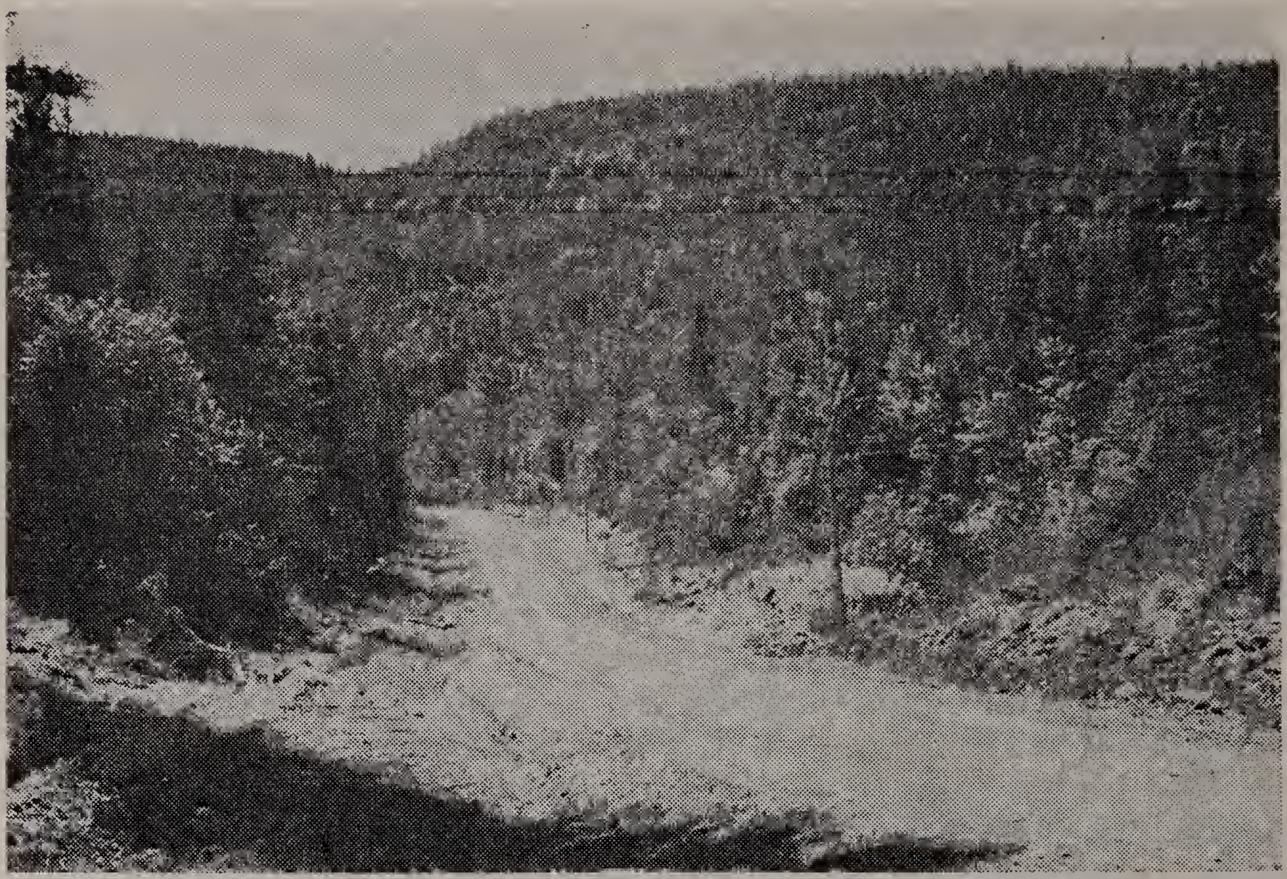

Fig 22 Scattered sugar maple on a northeast slope south of Rapids Depot. Spruce and fir are prominent on the hilltop.

but portions have been deeply incised by the rivers. White pine is generally abundant, but balsam fir, white spruce, black spruce and white birch predominate. Red spruce occurs at high elevations.

On the north, the District is bordered by lower elevations and the presence of sugar maple and beech. The south boundary forms along the rugged relief of the Nipisiguit District. The soils are sandy loams and loams, occasionally containing calcareous fragments, and are derived from shale, sandstone and volcanic rocks. In many areas they are poorly drained or shallow. Cedar and black spruce swamps are common. Fires have swept portions of the District, especially in the Upsalquitch River valley where jack pine, white pine and red pine occur. On well-drained sites the pines appear to do better than balsam fir.

Nipisiguit District: Formed on the broad, dissected peneplain, generally 2,000 feet above sea level, comprising the height of land between the St. John, Miramichi, Upsalquitch and Nipisiguit Rivers. The mountainous terrain produces great variability in climate, the higher mountains being frequently shrouded in cloud while the valleys are droughty and prone to burning. Fig. 23 illustrates black spruce and white pine in the valley bottom, and small dense black spruce on the hilltops. Balsam fir, black spruce and white spruce are found on the slopes, but balsam fir and white birch cover some of the hills where the soils are deeper. Jack pine is common where burning has been frequent, but some shallow soils have not regenerated.

The District is bordered by the 1,500-foot contour where it separates the rugged terrain from the more rolling relief of the adjacent Districts to the north and south. Tolerant hardwoods, mostly lying below 1,800 feet in elevation, form the west boundary. The granite and gabbro core of the New

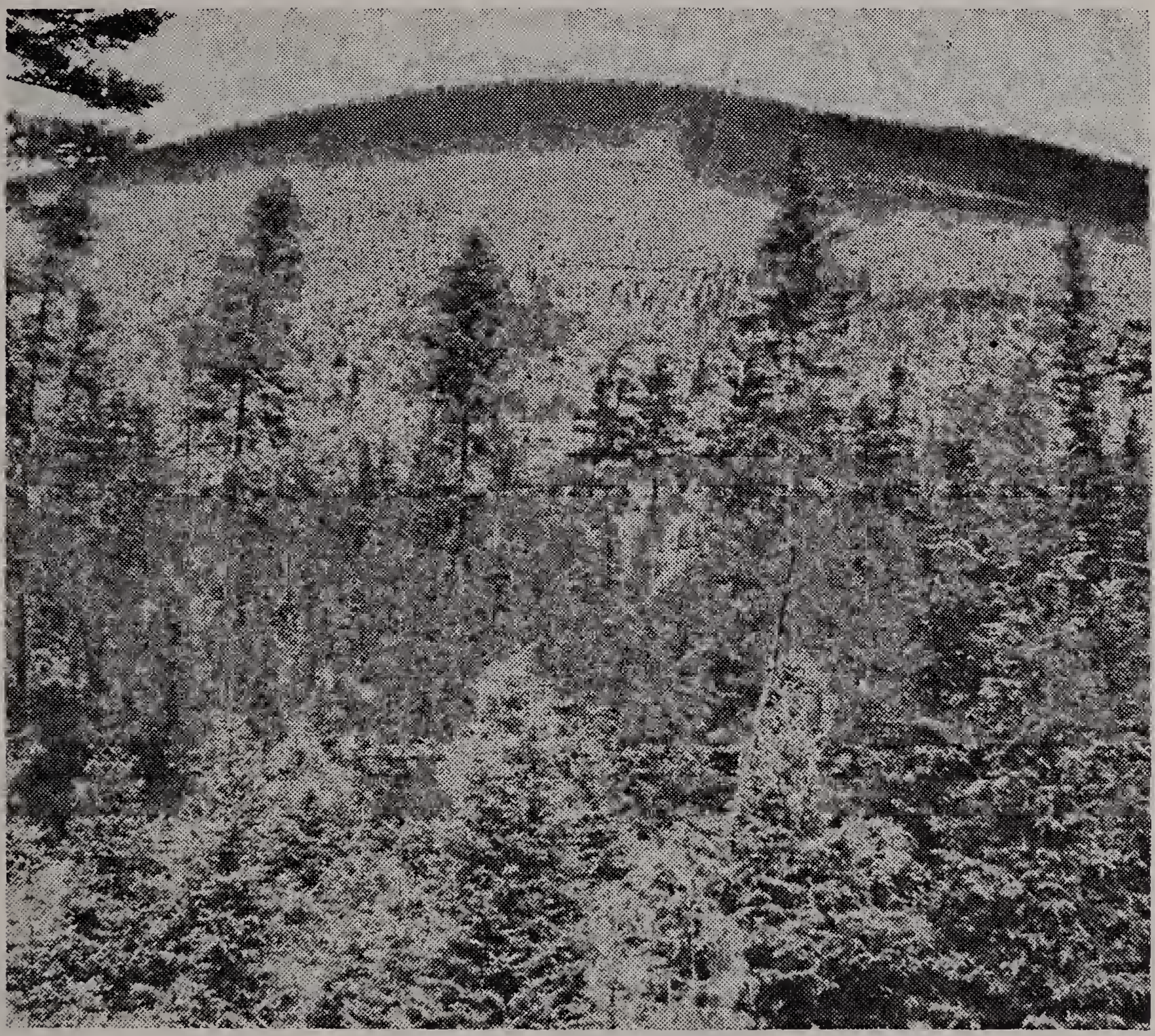

Fig 23. Mountainous terrain in the Nipisiguit District. Black spruce and white pine are found in the valleys; unmerchantable black spruce on the hilltops.

Brunswick Highlands is the main underlying bedrock, but chlorite schists and argillites are common. The resulting soils are variable; coarse, loamy sands on the granite; stony, sandy loams on the schists. The rugged terrain and shallow soils make for difficult logging.

Tuadook District: Comprised of the rolling land between the Nipisiguit District and the tolerant hardwoods to the south and east. The main rivers tend to follow broad, flat-bottomed valleys separated by irregular hills. Sugar maple may occur on favourable sites, but white birch, yellow birch and red maple comprise most of the broadleaf element in the mixedwood stands on the hills. Jack pine is common on burned land; when it is not present, scattered white pine overtops dense balsam fir, black spruce and white spruce. Red spruce may be abundant locally.

Rugged terrain above the 1,500-foot contour forms the western border of the District, while tolerant hardwoods border it on the south and east. The soils are stony, sandy loams derived from chlorite schists, argillites, quartzite and local outcroppings of granite and volcanic rocks. Sands and coarse gravels are common along the valleys. The pines and spruces are probably best suited to the District, as the fir tends to be somewhat inferior.

10. Gaspé — Cape Breton Ecoregion

Balsam fir, white birch, white spruce, and occasionally yellow birch, red maple and black spruce comprise the zonal association. Spruce is less prominent than in the New Brunswick Highlands Ecoregion and white pine is rare. Risk of fire appears to be low, for stands of fire origin are uncommon. Observations of the characteristic inverted soil profiles indicate that old growth forests are normally destroyed by wind, if not by insect attack. Balsam fir regenerates quickly, grows to large sizes, and remains sound for upwards of 100 years. The heart-leaf birch is characteristic, and although much of it was killed by 'dieback', it normally forms large, quality timber.

The lesser vegetation is luxuriant on all but the driest sites. Mountain maple and hobblebush frequently form a dense shrub canopy. Below it, wood fern covers wood-sorrel and numerous mosses. Schreber's moss and bunchberry are common on dry sites; spring-beauty and Dutchman's-breeches frequent rich seepage sites. Sheep laurel, wintergreen and blueberry are uncommon.

As in the New Brunswick Highlands Ecoregion, one of the major considerations in forest management is to reduce the susceptibility of the forest to attack by the spruce budworm (Prebble, 1951). Shrub competition, mainly from mountain maple, is a problem on much of the area, but according to Vincent (1956) suppressed regeneration of spruce and fir is available. The abundant advance growth of balsam fir under mature fir is illustrated in Fig. 24.

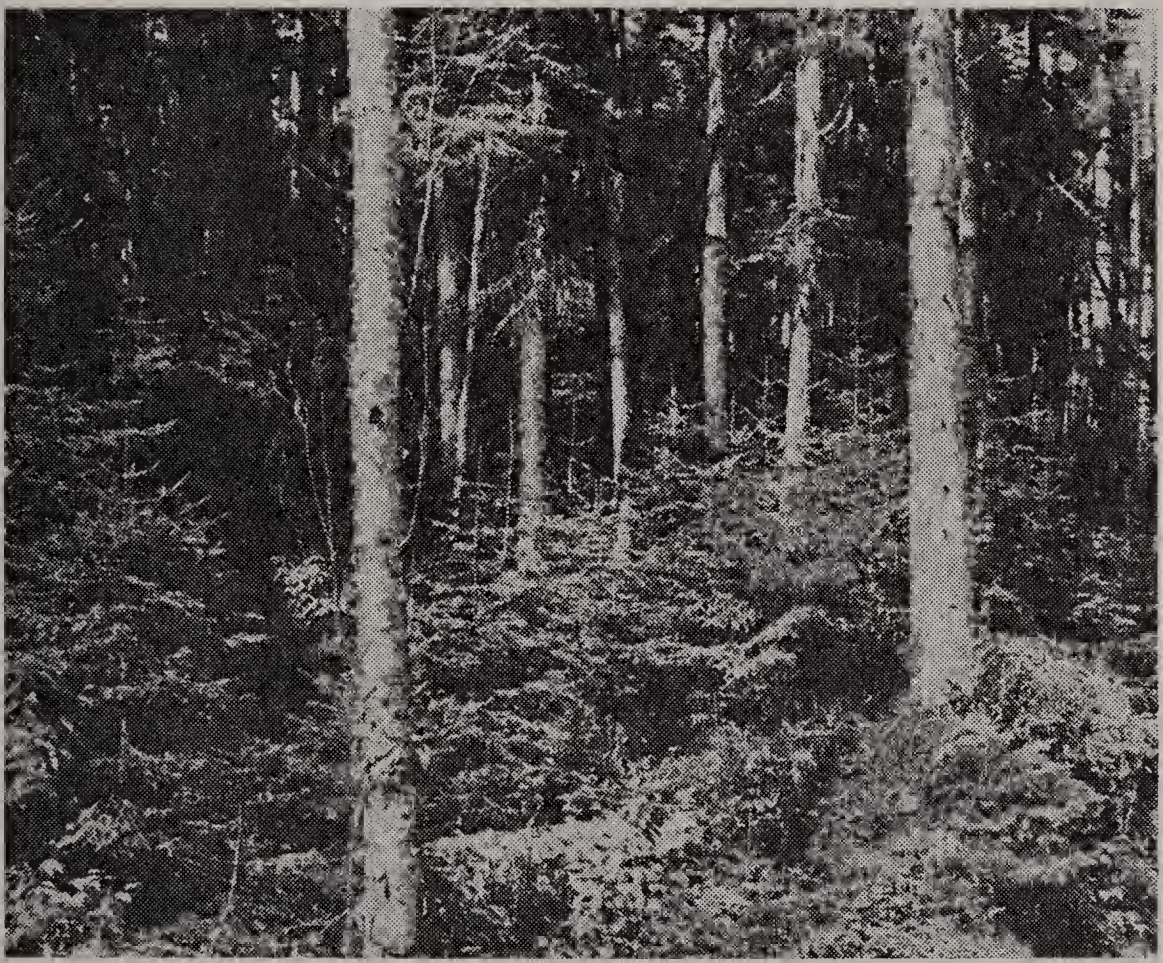

Fig 24. Balsam fir advance growth under old-growth fir, Green River District.

High summer precipitation, and low temperatures distinguish the climate. Meteorological records are not available for the Cape Breton Island portion, but surface runoff data for the Northeast Margaree River, which rises mainly in this Ecoregion, indicate 50 inches of runoff annually. Owing to the high elevations, fog and low clouds frequently shroud all but the lowest valleys. Tree growth is rapid in spite of the short season.

The underlying bedrock is mainly metamorphic: slate and argillite in New Brunswick; argillite, volcanics and granite in Cape Breton Island. The associated soils are moderately fertile and most are well drained.

Green River District: Consists of a broad ridge in northwestern New Brunswick, part of the Gaspé upland, rising in places to 2,000 feet above sea level. Air masses coming from the west are forced upward, producing the moist climate indicated by data from Summit Depot. The forest is mainly balsam fir, white birch and spruce, and differs from the Cape Breton Highlands District only in the greater height of the birch and fir. This appears to result from less exposure to wind.

Tolerant hardwoods form the south border of the District, about 1,800 feet above sea level, while white pine and stands of fire origin below the 1,500-foot contour form the boundary on the north. Stony loam and silt-loam soils derived from slates, argillite and conglomerate cover the strongly rolling terrain. Limy fragments may be found in much of the fractured bedrock. Although the soils are often shallow, the soft bedrock and strong vertical cleavage permit deep rooting. These features are equally favourable for logging operations because a bulldozer blade is usually sufficient to make rock-cuts. However, the rough topography makes for difficult logging.

Cape Breton Highland District: Comprised of the upper slopes of the northern Cape Breton Highlands, mostly more than 1,000 feet in elevation, but not including the 1,500-foot level of the Northern Plateau. The moist climate results from air masses moving over the high elevations. Balsam fir, white birch and spruce form the characteristic association, Fig. 25, but continuous winds from the surrounding open water exert a strong influence on growth. For the most part, the trees are seriously shortened only on the ridges and exposed slopes. Growth is comparable to that of the Green River District on the protected sites.

The District comprises a belt of ridges and deeply incised valleys around the Cape Breton Plateau. The outside border is marked by the presence of tolerant hardwoods, mainly between the 700- and 1,100-foot contours; the beech and sugar maple may rise to higher elevations along the west than on the east. The inland boundary is located near the 1,500-foot contour which outlines most of the flat portion of the Northern Plateau. The eastern part of the District in the rain-shadow of the plateau tends to be drier, and may be comparable to the New Brunswick Highlands Ecoregion. The soils are variable, but consist mainly of sandy loams derived from sandstones, conglomerates, igneous and metamorphic rocks, and granite. Shallow soils and bare bedrock are frequent. An extremely rugged terrain results from the many narrow valleys through the District and makes for some of the most difficult logging in the Maritime Provinces.

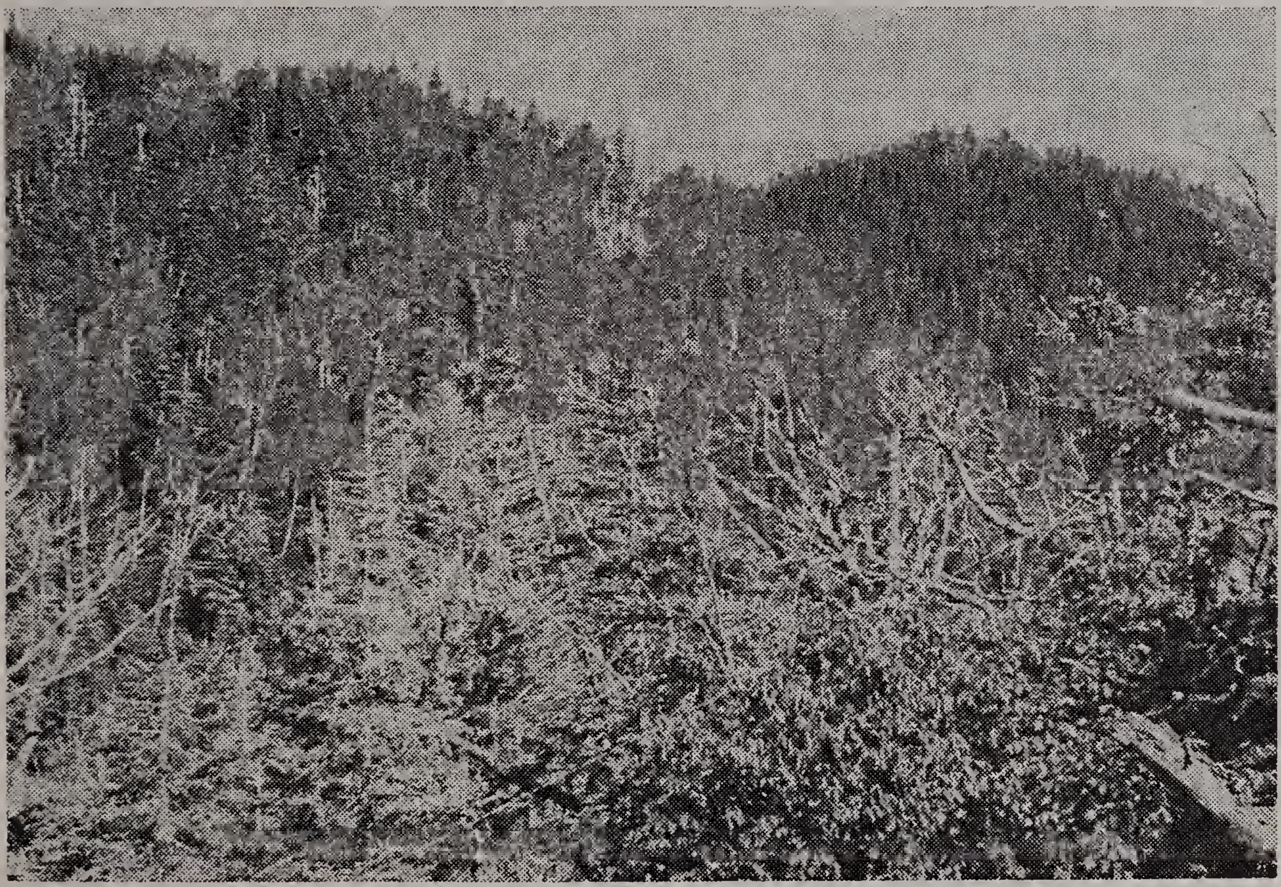

Fig. 25. Balsam fir, white birch and yellow birch on a slope, Cape Breton Highlands District, Gaspé-Cape Breton Ecoregion.

Spruce Taiga Zone

Short, dense spruce and fir alternates with shrub barrens and peat bogs on the flat central portion of the Cape Breton Plateau. The vegetation has been termed 'taiga' for its apparent similarity to Taiga described by Hustich (1949) in Quebec, and the northern taiga mapped by Alexin *etal.* (1957) in the Soviet Union*. Some features of the landscape suggest that the vegetation pattern is alpine. But there is such a similarity to the non-alpine forests of Quebec and Newfoundland that the Cape Breton Island component cannot be singled out. Some distinguishing characteristics are noted in the description of the single Ecoregion representing this zone in the Maritime Provinces.

11. **Cape Breton Plateau Ecoregion** (Cape Breton Plateau District)

Consists of the oval tableland forming the Cape Breton Plateau. The essentially stable association on the few deep, well-drained soils is stunted black spruce, white spruce, balsam fir and white birch. Mountain-ash is scattered and balsam fir predominates in a few areas. The shallow soils on the low ridges support an ericaceous shrub cover, while sedge and sphagnum bogs are found on seepage slopes and in depressions. The characteristic habit of the forest is illustrated in Figure 26.

Sheep laurel, rhodora, Labrador-tea and Schreber's moss figure most prominently in the lesser vegetation of the forested portions. The shrubs also form a dense cover on the exposed barrens, along with lichens and sphagnum. Roland (1944) lists a number of northern species found on the area.

Very little of the District is capable of an economic level of wood production, but a few sites are sufficiently sheltered to permit satisfactory height growth of spruce. Stunting from exposure to wind, as well as windthrow and crown breakage, limit the quantity of timber that can be grown on the better sites. Most of the latter are accessible from the Cape Breton Highland District.

Meteorological records from Burgeo, Newfoundland, where a comparable vegetation is reported, give an indication of the climate of the plateau. At Burgeo the June, July, August temperature is 53.3 degrees; the potential evapotranspiration of 17.8 inches almost equals the limit beyond which, according to Hare (1950), the climate is too severe for a closed forest.

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*These authors recognize a southerly closed-forest taiga in the Soviet Union, but do not equate the term to 'boreal' as suggested by Putnam (1952) and Wilde (1958).

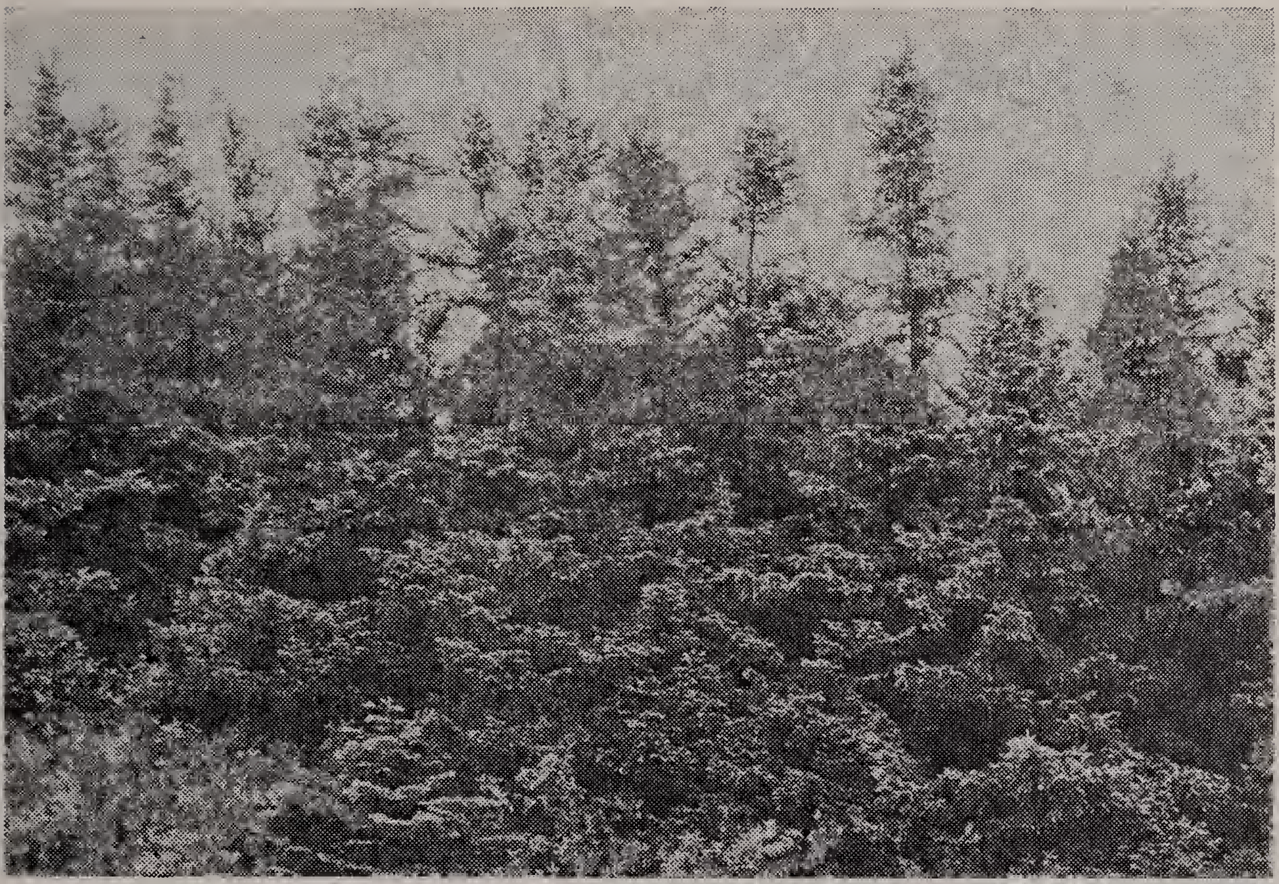

Fig. 26. Dense black spruce and balsam fir on an upland site in the Cape Breton Plateau District.

The District is bounded by the 1,500-foot contour, depending on the local exposure. Other 1,500-foot uplands are found to the south, in the Cape Breton Highlands District, and if flat with dense stands and upland barrens, should be included. The soils are shallow sandy loams largely derived from the granite. Azonal soils include the shrub-covered bedrock and the peat bogs. Problems relating to poor drainage, and the presence of peat bogs on slopes create difficulties for logging.

SUMMARY

Objectives for a classification of forests to be useful in forestry practice are discussed. Forest site classification is recognized as the means for describing the forest environment on a local level and as the primary level of forest classification. It is therefore used as a basis for outlining large geographic areas within which site types support a relatively uniform ecological relationship and have a limited range in regional environment. The proposed classification is designed to divide the regional variation in vegetation and environment into a

system of segments to be shown in geographical units known as Ecoregions. These Ecoregions do not form continuous belts, but often consist of several widely scattered components. Smaller geographic units distinguished by locality and a local pattern of sites are called Site Districts. The Ecoregions are grouped into higher categories called Forest Zones, characterized by the predominating species in the stable forest.

Brief descriptions are given for the seven Forest Zones in the Maritime Provinces. Eleven Ecoregions, containing fifty-five Site Districts, are described. Extreme local variations in climate and tree distributions along the coasts and on the irregular uplands has contributed to the complexity of the subject.

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LIST OF COMMON AND SCIENTIFIC NAMES

Trees

Balsam fir	*Abies balsamea* (L.) Mill.
Basswood	*Tilia americana* L.
Beech	*Fagus grandifolia* Ehrh.
Black ash	*Fraxinus nigra* Marsh.
Black cherry	*Prunus serotina* Ehrh.
Black spruce	*Picea mariana* (Mill.) BSP.
Bur oak	*Quercus macrocarpa* Michx.
Butternut	*Juglans cinerea* L.
Eastern hemlock	*Tsuga canadensis* (L.) Carr.
Heart-leaf birch	*Betula cordifolia* Regel
Ironwood	*Ostrya virginiana* (Mill.) K. Koch
Jack pine	*Pinus banksiana* Lamb.
Mountain-ash	*Sorbus* L. (Spp.)
Norway spruce	*Picea abies* (L.) Karst.
Pin cherry	*Prunus pensylvanica* L.f.
Red maple	*Acer rubrum* L.
Red oak	*Quercus rubra* L.
Red pine	*Pinus resinosa* Ait.
Red spruce	*Picea rubens* Sarg.
Silver maple	*Acer saccharinum* L.
Sugar maple	*Acer saccharum* Marsh.
Tamarack	*Larix laricina* (Du Roi) K. Koch
Trembling aspen	*Populus tremuloides* Michx.
White ash	*Fraxinus americana* L.
White birch	*Betula papyrifera* Marsh.
White cedar	*Thuja occidentalis* L.
White elm	*Ulmus americana* L.
White pine	*Pinus strobus* L.
White spruce	*Picea glauca* (Moench) Voss
Wire birch	*Betula populifolia* Marsh.
Yellow birch	*Betula lutea* Michx. f.

Shrubs

Beaked hazel	*Corylus cornuta* Marsh.
Bearberry	*Arctostaphylos uva-ursi* (L.) Spreng.

Shrubs (Cont'd.)

Black-crowberry	*Empetrum nigrum* L.
Black huckleberry	*Gaylussacia baccata* (Wang.) K. Koch
Blueberry	*Vaccinium* L. (Spp.)
Broom-crowberry	*Corema conradii* Torr.
Cowberry	*Vaccinium vitis-idaea* L. var. *minus* Lodd.
Greenbrier	*Smilax rotundifolia* L.
High-bush blueberry	*Vaccinium corymbosum* L.
Hobblebush	*Viburnum alnifolium* Marsh.
Inkberry	*Ilex glabra* (L.) Gray
Labrador-tea	*Ledum groenlandicum* Oeder
Mountain-holly	*Nemopanthus mucronata* Raf.
Mountain maple	*Acer spicatum* Lam.
Rhodora	*Rhododendron canadense* (L.) Torr.
Sheep laurel	*Kalmia angustifolia* L.
Speckled alder	*Alnus rugosa* (Du Roi) Spreng. var. *americana* (Regel) Fern.
Wintergreen	*Gaultheria procumbens* L.
Witch-hazel	*Hamamelis virginiana* L.
Witherod	*Viburnum cassinoides* L.

Mosses and Herbs

Bigleaf aster	*Aster macrophyllus* L.
Black raspberry	*Rubus occidentalis* L.
Bloodroot	*Sanguinaria canadensis* L.
Bracken	*Pteridium aquilinum* (L.) Kuhn var. *latiusculum* (Desv.) Underw.
Bristly clubmoss	*Lycopodium annotinum* L.
Bunchberry	*Cornus canadensis* L.
Buttercup	*Ranunculus* L. (Spp.)
Canada Maianthemum	*Mianthemum canadense* Desf.
Canada raspberry	*Rubus strigosus* Michx. var. *canadensis* (Richards.) House
Cloudberry	*Rubus chamaemorus* L.
Cucumber-root	*Medeola virginiana* L.
Dogtooth-violet	*Erythronium americanum* Ker
Dutchman's-breeches	*Dicentra cucullaria* (L.) Bernh.
Four-furrowed Enchanter's Nightshade	*Circaea quadrisulcata* (Maxim.) Franch. & Sav. var. *canadensis* (L.) Hara
Gold-thread	*Coptis groenlandica* (Oeder) Fern.
Goldie's fern	*Dryopteris goldiana* (Hook.) Gray
Maidenhair fern	*Adiantum pedatum* L.

Mosses and Herbs (Cont'd.)

Naked miterwort	*Mitella nuda* L.
Schreber's moss	*Pleurozium schreberi* (BSG.) Mitt.
Sedge	*Carex* L.
Shining clubmoss	*Lycopodium lucidulum* Michx.
Sphagnum	*Sphagnum* Dill. (Spp.)
Spikenard	*Aralia racemosa* L.
Spring-beauty	*Claytonia caroliniana* Michx.
Sweet-cicely	*Osmorhiza claytonii* (Michx.)
Wild ginger	*Asarum canadense* L.
Wild red raspberry	*Rubus strigosus* Michx.
Wood fern	*Dryopterus spinulosa* (O.F. Muell.) Watt
Wood-sorrel	*Oxalis montana* Raf.
Yellow violet	*Viola pensylvanica* Michx. var. *leiocarpa* (Fern. & Weig.) Fern.
Zigzag smilacina	*Smilacina racemosa* (L.) Desf.

GLOSSARY

Association—A recurring community of one or more tree species, occurring in combination.

Ecoregion—The geographic unit within which relationships between species and site are essentially similar, and within which silvicultural treatments may be expected to obtain comparable results; recognized by the characteristic species composition and development on the zonal site type.

Forest Classification—A systematic arrangement of forest land, or potential forest land, according to prescribed criteria; understood to exist simultaneously at different levels of abstraction as determined by the purpose and prerequisite criteria at each level.

Forest Zone—A group of ecoregions having affinities of dominant species composition.

Potential Evapotranspiration—The amount of water that will be lost from a land area covered with vegetation if there is adequate water in the soil at all times; an expression of atmospheric demand, regardless of whether the vegetation and supply of soil moisture are actually present.

Region—An area of any size throughout which accordant areal relationship between selected phenomena exists (Whittlesey, 1954).

Site District—A subdivision of the Ecoregion based on pattern of relief, drainage, or type of bedrock; may have ecological significance, but not by definition.

Site Type—A mappable unit consisting of the complex of physical and biological factors for an area which determine what forest or other vegetation it may carry (Br. Comm. For. Term. 1953), with the restriction that biological factors include only such aspects of plant and animal life as provide the physical requirements of the tree community.

Zonal Site Type—The site type exemplified by a well-drained, sandy-loam soil on a gentle mid-slope and characterized by the development of a zonal soil profile.

97th ANNUAL MEETING

PRESIDENTIAL ADDRESS

J. R. Dingle

September 28, 1959

The Council decided to call the annual Business Meeting one month earlier than has been traditional, in the hope that our season may have a fair start before Christmas is upon us, but also with the hope that a corresponding advance in the closing meeting will not be necessary next spring.

During the past year, the Institute had to mourn the loss by death of only one member, but that one was Mr. F. W. W. Doane of Halifax, until that time our member of longest standing. He was a link with the early years of the Institute, for he was elected to membership on November 3rd, 1886, when he was City Engineer, and the original Nova Scotian Institute of Natural Science was only twenty-four years old. Besides remaining a member for so many years, he was also active in its affairs, and indeed was elected to the first Council of the modern Institute after its incorporation by Act of the Legislature in 1890.

Besides the annual Business Meeting, the Institute held two extraordinary meetings and seven ordinary meetings, including a joint one with the Valley Chapter at Wolfville. A total of eighteen papers was delivered at the ordinary meetings and the average attendance was thirty-five, with a maximum of fifty at the combined session at Wolfville. The extraordinary meetings were addressed by Dr. Eugene Hayden, Plant Pathologist of the Rust Prevention Association of Minneapolis, and by Dr. Tage Astrup, of the Biological Institute of the Carlsberg Foundation, Copenhagen, and world renowned for his studies in the field of blood coagulation.

By a vote of members at the last regular meeting, the elective offices of Corresponding Secretary and Librarian were abolished. Hereafter, their duties will be assumed by a Librarian who will be appointed by the Council.

The new venture of an Essay contest was launched this year, rather tardily. Only five essays were received, all in the field of Biological sciences. The prize of $50.00 was won by David Michael Maxwell, then in his first year at St. Mary's

University. Mr. Maxwell is now in Europe and I am happy to say has reported that the prize money was invested to fullest advantage in books purchased at a well-known establishment in London.

Our membershop has remained approximately steady at just under three hundred as it has since 1952. This is not unexpected, because since that time there has not been any great increase in our scientific community, and it has not been our policy to make a concerted drive for new members just for the sake of a large membership. Rather we acquaint newcomers to the region with the existence of the Institute and hope that they will feel it advantageous to participate as members. But our Institute cannot be of advantage to anyone unless some are willing to contribute to its functions, and the greater the number of contributors the greater the mutual advantage.

The numbers I have already mentioned carry an implied warning, which becomes clearer when they are compared with statistics for previous years. In the last year, there was a marked decline in attendance at regular meetings. Since 1953, the average was closer to fifty, with a high of ninety and a low of thirty-four. In addition to this, the number of papers contributed was down somewhat, but even more seriously, there was considerable difficulty in scraping up many of those that were given. The Secretary will vouch for this, because the task fell largely upon him. There were times when your Council was uncertain whether it would be possible to call the next regular meeting, and it was left dependent on whether the Secretary could find another paper to make a satisfactory program. This situation does not compare well with earlier years. In 1889-90, for example, the President reported that from a total of only fifty-seven ordinary members sixteen papers were contributed. Moreover, most of these were true research papers, of the type acceptable for present day meetings.

This state of affairs has been a cause of discouragement and considerable concern to those who have been entrusted with the affairs of the Institute. Why this rather sudden decline in interest on the part of members? A criticism often heard is that the Institute is no longer a suitable forum for the presentation of research papers because its membership is too heterogeneous. The author cannot get the proper appreciation or criticism of his work that he seeks, and his audience retaliates by saying they can't understand his language. Are not both expecting too much of such an Institute as ours in an age when it is becoming difficult for biologists to consult with physicists, and physicists tend to speak only with God? Of course the Institute is not the equivalent of an international Congress on Biochemistry, nor was it even intended to be anything of the kind from the beginning. I think, rather, that it should be regarded as a means of acquainting each of us with what is going on in the several institutions in our city, and which we so seldom take the opportunity to visit. Besides satisfying a natural curiosity, I know from my own experience that our meetings can even be the source of new ideas from time to time. In a similar vein, President J. G. MacGregor in 1890 said: "The number of our scientific workers in all departments is but small, and it cannot but be beneficial that we should be banded together and be enabled thereby to secure the stimulus which springs from a sympathetic, even though not a wholly intelligent interest''. Take that as you will!

If this purpose of the Institute be granted, then it follows that each speaker should couch his remarks in plain language so that those most removed from his subject will at least know where and why he started in his work, and what the conclusions are. This is surely evident to all of us — and we have some outstanding members who are masters at this art — but still there are some who do not follow such advice in practice. I trust that all of you present, who by your very presence give proof of a more than average interest in your Institute, will persistently spread this advice among your associates, while at the same time urging them to open some of the secrets of their work to their fellow scientists.

There is another criticism allied to that just discussed. Some say many of our papers are not worthy of presentation, but those that are most often heard in this way do not themselves contribute, or are not members at all. Your Council earnestly wishes that such individuals would help raise our standards, but with the proviso that the rule of plain language be adhered to.

It may be also that an increasing number of activities non-scientific in nature — are demanding more of our member's times. If so, there is probably little that can be done, but this is not likely the case in view of the rather sudden onset of the symptoms. It may also be that most of us are in the middle of problems, and that results will appear more or less simultaneously. If so, we can still hope that this will be reflected in a more thriving Institute very soon.

Those who are wise in the affairs of organizations say that they tend to move in cycles of activity. This may well apply to our Institute, for even in 1865, when the old Nova Scotian Institute of Natural Science held summer Field Meetings, the President reported: "The Chief Commissioner of Railways had very kindly offered free passage over the lines to members attending Field Meetings, and every inducement was therefore offered to those who desired to participate in such meetings; but he was very sorry to say that but a very small proportion of the members took part in these excursions". Yet the Institute has certainly grown and flourished since then, and with the proper spirit in members, will, I am sure, do so again. Our one hundredth year will begin in the Fall of 1961, and our one hundredth birthday will occur three years from now. Let us not, as one member feared, celebrate it with our demise.

There are, no doubt, several considerations and factors I have not dealt with, but I am sure that the incoming Council will welcome any suggestions and advice from members. I hope however, you will not leave it all to the Council, but that each will do a little towards rejuvenating the Institute.

Gentlemen, it has been an honour to serve as your President during the past year, and I wish sincerely to thank all the members of the Council who made it so easy to do so.

PROCEEDINGS OF MEETINGS

Session of 1959-60

(Meetings were held in the Medical Sciences Building, Dalhousie University.)

98*th Annual Business Meeting, September* 28, 1959.

The meeting was presided over by the President Dr. J. R. Dingle whose presidential address appears on page 168 of the Proceedings. The Officers presented their reports.

The Treasurer, C. R. Masson, reported:

Receipts	$ 899.83
Expenditures	1,469.14
Invested Funds	1,000.00
Bank Balance, September, 1959	883.36

The Corresponding Secretary, P. L. Hoogland, reported:

This will be the last report by a Corresponding Secretary. At the business meeting held on May 11th, 1959, the Constitution and By-Laws of this Institute were amended to permit the fusion of the two secretarial offices into one and to make it possible to appoint rather than to elect a Librarian. This was done mainly because the work of the Corresponding Secretary had developed into being concerned only with exchange of Publications which could be handled more efficiently by the Librarian; it involved little or no correspondence that could not be handled by either the Librarian or the other Secretary.

That this decision has been a good one is borne out by my having hardly anything to report. During the year, we answered the usual number of requests for reprints or for separate issues of the Proceedings; we also mailed out the latest issue of the Proceedings, Vol. 24, part 3, to all members and exchange addresses.

On June 1st, 1959, we began turning over our work and inventory to the Librarian; this change-over is now completed.

Finally, I should like to remark that holding the office of the Corresponding Secretary during the past six or seven years has given me an occasional headache but that this was made easily bearable by also providing much pleasure and a reasonably good stamp collection.

The Librarian, Miss E. M, Campbell, reported:

There have been no significant changes in the administration of the Institute's library in the current year. The binding program is being maintained, and the policy of having the journals of an additional society bound each year, is being continued.

The work of checking and correcting the entries of all the storage material is continuing, and material that is not kept on the shelves of the Foundation Library is packaged and arranged in order in the attic.

To the approximate 500 societies exchanging publications with the Institute, several new ones have been added. Several new societies, particularly those of Eastern Europe, sent their publications to the library asking for exchanges. We kept these for some time to ascertain their usefulness, and after discussion with members of the Institute we decided to ask them to remove the name of the Institute from the mailing list.

This summer we made a complete check of all the holdings of the Institute, in the attic of the Technical College, the Medical Library, and Fisheries Research Board Technical Station and the Research Foundation. Unfortunately there are no parts of any volumes before volume 7, and only one or two numbers of volumes 7 and 8. There are tremendous numbers of parts of volumes 15-20, as well as reprints of articles from earlier volumes. The list would be too long to mention here, but these reprints have been packaged and labelled and are stored in the attic. Anyone wishing to see these may do so.

The Research Foundation is continuing to finance subscriptions to societies which are no longer sending their material on an exchange basis.

Each year the need for more space becomes greater.

The bulk of the correspondence dealt with since June of 1959, when the offices of Librarian and Corresponding Secretary were combined, was related to the exchanges. Requests for missing numbers were dealt with and sent when available. All letters and receipts for exchanges are kept on file in the library and are available for checking by members of the Institute.

The Editor, L. B. Macpherson, reported:

During the year Part 3 of Volume 24 of the Proceedings was published and distributed to members and exchange institutions.

There is one manuscript on hand and negotiations are under way for enough additional material for Part 4. A larger manuscript for Part 1 of Volume 25 has been promised. We are looking forward to publishing a revised edition of the Flora of Nova Scotia, by Roland and Smith in the near future.

The Editor wishes to thank his Editorial Board, Dr. Dixie Pelluet, Dr. J. A. McCarter, and Dr. A. D. MacDonald, for their co-operation and advice.

Officers elected for the year 1959-60 were:

President	Dr. J. R. Dingle
First Vice-President	Dr. W. J. Archibald
Second Vice-President	Dr. J. A. McCarter
Treasurer	Dr. C. R. Masson
Recording Secretary	Mr. H. S. Heaps
Editor	Dr. L. B. Macpherson
Librarian	Miss E. M. Campbell
Council	Dr. E. H. Anthony, Dr. J. R. Greenblatt, Dr. G. O. Langstroth, Dr. A. D. Macdonald, Dr. W. Yaphe,
Auditors	Dr. H. L. Bronson Dr. H. D. Smith

New Members:

During the year the following new members were proposed and were elected by Council, Ordinary: J. M. Teal, Judy Ball, J. P. Burden, L. Cudkorvicz, A. A. Mills, G. Touazzi, J. P. Nowlan, J. P. Wright.

Student Members: P. Hochachka, G. G. R. Buchbinder, J. Gibson, K. Halcrow, C. G. White, F. W. Dobson, M. H. Jericho, R. H. March, P. J. Whelan, L. Van O. der Zwan.

1*st Ordinary Meeting*, October 19, 1959.

Papers: 1. "Recorsinol Reagent for the Determination of Fructose," by W. Yaphe; 2. "The Stimulation of Growth of Fungi Isolated from Pulp Mills by White Water", by D. Brewer.

Extraordinary Meeting, November 2, 1959.

Dr. Edwin A. Dawes of the Biochemistry Department of the University of Glasgow addressed the Institute on "Some Aspects of the Metabolism of Zymosarcina Ventriculi".

Dr. Dawes visited Halifax as a Visiting Lecturer in the Biochemistry Department of Dalhousie University.

2*nd Ordinary Meeting*, December 14, 1959.

Papers: 1. "On the Mechanism of Intestinal Secretion, the Enterolipomicron", by C. B. Weld; 2. "The Nature of the Proteins of Fish Muscle", by J. R. Dingle.

3*rd Ordinary Meeting*, January 11, 1960.

Papers: 1. "The Comparative Biochemistry of some Subtropical Marine Invertebrates", by P. H. Odense; 2. "Water Conduction in Large Woody Stems", by K. N. H. Greenidge.

4*th Ordinary Meeting*, February 8, 1960.

Papers: 1. "Some Anabolic Aspects of Protein Metabolism in Riboflavin Deficiency in the Rat", by W. W. Hawkins and S. Mookerjea, 2. "Determination of Oxygen in Iron and Steel by Isotope Dilution", by M. L. Pearce and C. R. Masson; 3. "Elaidinization of Oleic Acid with Selenium", by R. G. Ackman.

5*th Ordinary Meeting*, March 14, 1960.

Papers: 1. "Corrosion of Aluminum in High Temperature Water", by D. F. MacLennan; 2. "Semiconductor Properties of Some Natural Sulphides", by G. A. Collins; 3. "Bacterial Effect and Radiophosphorus Assimilation in Organic States in Salmon", by P. N. Scrivastava.

6*th Ordinary Meeting*, April 11th, 1960.

This was a joint meeting with the Valley Chapter and was held in Halifax.

Papers: 1. "Activity of Juvenile Chum Salmon During Adaption to Sea Water", by A. H. Houston; 2. "The Economy of Anaerobic Yeast Growth", by J. G. Kaplan; 3. "On the Relations of Peridotite and Dunite of Table Mountain, Western Newfoundland", by D. Hope-Simpson.

7th Ordinary Meeting, May 9th, 1960.

Papers: 1. ”The Soluble Collagen of Cod”, by E. G. Young and J. W. Lorimer; 2. “Utilization of Calcium and Iron by the Rat during Administration of Ethylenediaminetetraacetate”, by W. W. Hawkins and B. A. Larsen. 3. “Some Metabolites of Fluoroacetic Acid in Yeast Cells”, by J. G. Aldous.

PROCEEDINGS OF MEETINGS

(Valley Chapter)

Session of 1959-60

The Valley Chapter held six meetings.

Annual Business Meeting, November 2, 1959.

Officers elected for the year 1959-60 were:

President	Mr. K. A. Harrison
Vice-President	Dr. E. C. Smith
Treasurer	Dr. A. D. Crowe
Secretary	Mr. A. W. MacPhee
Council	Dr. D. C. MacKay

Paper: “A Type of Modified Spray Program for Apples in New Jersey”, by H. Specht.

2nd Meeting, December 7, 1959.

Papers: 1. “Senescence and Disease Resistance in Plants”, by R. A. Ludwig; 2. “Taxonomy of Crab Spiders”, by C. D. Dondale.

3rd Meeting, January 4, 1960.

Paper: “Shell-Heap Archeology of Southwestern Nova Scotia”, by J. S. Erskine.

4th Meeting, February 1, 1960.

Papers: 1. “Metabolic and Genetic Studies in Rhizobium”, by Miss J. Ellis; 2. ”Some Aspects of Chemical Thinning of Apples”, by A. D. Crowe.

5th Meeting, March 7, 1960.

Papers: 1. "Some Aspects of Predation in Apple Orchards", by F. T. Lord; 2. "The Electrification of Water Drops", by R. H. Magarvey.

6th Meeting, May 2, 1960.

Papers: 1. "Reptiles and Amphibians of Prince Edward Island", by F. Cook; 2. "Meeting Agricultural Problems During the Past Fifty Years", by J. F. Hockey.

ABSTRACTS

(Papers read before the Institute but not published in the Proceedings.)

Resorcinol Reagent for the Determination of Fructose. By W. Yaphe, Atlantic Regional Laboratory. (Read October 19, 1959). The conditions which affect the development of colour in the reaction of fructose with resorcinol have been investigated. It has been shown that (1) the stability of the colour is dependent upon the time of heating at 80°C, (2) the peak of maximum absorption is shifted from 520 mu to 550 mu with increase in the time of heating or the concentration of hydrochloric acid, (3) an impurity is present in commercial glacial acetic acid which affects the reaction, (4) the presence of ferric ions increases the absorption in the spectral region of 400 to 540 mu but has no effect at 550 mu.

A modified procedure for the determination of fructose is proposed.

The Stimulation of Growth of Fungi Isolated from Pulp Mills by "White Water". By D. Brewer, Atlantic Regional Laboratory. (Read October 19, 1959). In a basal medium which supported good growth of two species of fungi, incorporation of "white water" was found to increase their rate of growth. Preliminary efforts to separate the active agent have been carried out, and the presence of at least two substances has been demonstrated. One of them stimulated the growth of an isolate of *Phialophora fastigiata*, whilst the other stimulated the growth of an isolate of *Phoma sp.* The implications of the presence of these two substances in "white water" are considered.

On the Mechanism of Intestinal Secretion, the Enteroliponicron. By C. B. Weld, Dalhousie University. (Read December 14, 1959). In previous communications it has been shown that the enterolipomicron is a minute particle found in the intestinal lumen of the jejunum but not of the ileum, during secretory activity, and not while the intestinal loop is at rest. It differs markedly from the chylomicron in composition in that it contains much less lipid and more protein than the chylomicron particle. On the basis of this and on the enzyme activity of the particles, it was suggested that the particles are of intracellular or cytoplasmic origin.

The present study involves histological investigation using quick freeze methods of preservation before normal sectioning and also electron microscope studies of the intestinal wall. Specimens were taken during the resting period, during stimulation, and after stimulation. During the resting phase particules in the cytoplasm were seen by the electron microscope which were similar in every respect with the enterolipomicron in appearance. These particles disappeared from the cells within a very few minutes during stimulation. It thus appears that the enterolipomicrons consist of secretory granules and other particulate material in the cytoplasm and that they appear in the lumen of the intestine as part of a secretory mechanism. It is not clear how these particles are expressed from the cell but it would seem that there must be a major rupture of the cell wall and an evacuation of a large part of the cytoplasmic material. Our experiments suggest that the evacuation of these cytoplasmic particles into the lumen of the gut is part of a normal secretory process and should be so considered rather than as wear and tear of cells. As it is known that in some areas of the small intesting mucosal cells are regenerated every few hours, this would not be an unexpected finding.

THE NATURE OF THE PROTEINS OF FISH MUSCLE. By J. R. Dingle. Fisheries Experimental Station. (Read December 14, 1959). The results of a program for the investigation of the nature of fish muscle proteins, undertaken at the Halifax Technological Station of the Fisheries Research Board of Canada, are reviewed. Most of this work has dealt with cod. Some progress has been made in the fractionation of the mixture of saracoplasmic proteins and certain enzymic activities associated with them have been studied. Extracts containing the myofibrillar proteins have been studied under various conditions by means of the analytical ultracentrifuge, to reveal dissociations and/or associations of the component proteins. Of these components, tropomyosin, actin, and myosin have been isolated, apparently in fairly pure states. Some of their properties, physical and enzymic, have been investigated.

THE COMPARATIVE BIOCHEMISTRY OF SOME SUBTROPICAL MARINE INVERTEBRATES. By P. H. Odense, Fisheries Experimental Station. (Read January 11, 1960). In recent years it has not been surprising to find creatine present among the invertebrates. In the present study creatine was found in nine of seventeen gorgonian species examined. Three species appeared to contain traces of glycocyamine, a precursor of creatine. No other guanindine bases were detected and it can be concluded that if the gorgonians contain a phosphagen, it must be creatine phosphate.

Arginine was found in the echinoderms and the one tunicate species examined. The presence of arginine in the siphon muscles of the tunicate examined conflicts with other work on this group and stresses the necessity of making many comparisons before stating a generalization.

The pigments present in these marine invertebrates were also examined. A red pigment occurring in the siphons of a tunicate acted as a natural pH indicator. Two carotenoid pigments, mutatochrome and antheraxanthin, were found to occur in several of the gorgonians examined A porphyrin, pheophytin *a*, was found in the pentane extract of nearly all the gorgonians. It could not be shown whether or not these pigments, normally found in plant materials, were normal constituents of the gorgonians or were derived from the zooanthellae which dwell symbiotically with the gorgonians.

Extraction of the gorgonians with organic solvents yielded large amounts of organic material, including oils, waxes and some crystalline non-lipid compounds. One compound was obtained in relatively large quantities from pentane extracts of the gorgonian *Eunicea mamosa*. It it an optically active, unsaturated compound behaving like a lactone, with the empirical formula $C_{15}H_{22}O_3$. Other similar compounds have been isolated from other gorgonians. Some have been shown to possess antibiotic activity.

WATER CONDUCTION IN LARGE WOODY STEMS. By K. N. H. Greenidge, Dalhousie University. (Read January 11, 1960). Studies in the water relations of forest trees have been continued in Nova Scotia for a period of several years. Emphasis has been concentrated thus far on the mechanism of moisture movement in large woody stems. The rates and patterns of moisture movement in normal trees, and in individuals afforded drastic surgical treatment of conducting tissues have been investigated, and the results reviewed within the framework of current concepts of moisture movement in large plants.

SOME ANABOLIC ASPECTS OF PROTEIN METABOLOSM IN RIBOFLAVIN DEFICIENCY IN THE RAT. By W. W. Hawkins and S. Mookerjea, Atlantic Regional Laboratory. (Read February 8, 1960). In four experiments young rats were deprived of riboflavin. Depending upon the experiment, in 45-76 days their mean body weights were 10-15% lower than those of controls which had received the same amount of food, with riboflavin. The concentrations of blood haemoglobin, plasma protein, and liver nitrogen did not differ from those of the food controls. In the riboflavin-deficient animals the mean ratios of liver weight to body weight were 113-136% of those in the food controls, and the liver nitrogen as a proportion of the body weight was correspondingly 102-132%.

When the rats were subjected to protein depletion, then fed a diet high in protein, the concentrations of blood haemoglobin, plasma protein, and liver nitrogen fell and were restored approximately to the same extent and at the same rate regardless of the state of riboflavin nutrition. Even under these conditions the livers of the riboflavin-deficient rats tended to assume a greater proportion of the body weights. The mean ratios after protein repletion were 115-124% of these in the food controls, the liver nitrogen as a proportion of the body weight being correspondingly high.

The results of these experiments provided evidence that riboflavin deficiency in the rat does not impair the maintenance and synthesis of some of the most metabolically important proteins of the body, and tends to enhance the synthesis of liver protein.

DETERMINATION OF OXYGEN IN IRON AND STEEL BY ISOTOPE DILUTION. By M. L. Pearce and C. R. Masson, Atlantic Regional Laboratory. (Read February 8, 1960). The method of isotope-dilution, first applied to the determination of oxygen in metals by Grosse and his co-workers, has been refined and extended to the determination of oxygen in iron and steel over a wide range of concentrations. The results are consistently higher than the values obtained by the standard vacuum-fustion method, the discrepancy increasing as the oxygen content decreases. It has been shown conclusively that the results obtained by vacuum-fusion are in error, due probably to the adsorption of carbon monoxide by iron films. All results can be explained on the basis that 5.85 x 10^{-5} gm. oxygen per gm. of sample are lost by adsorption in each vacuum-fusion determination.

ELAIDINIZATION OF OLEIC ACID WITH SELENIUM. By R. G. Ackman, Fisheries Experimental Station. (Read February 8, 1960). The preparation of elaidic acid by simply heating oleic acid with selenium was introduced comparatively recently, superceding the classic preparation with oxides of nitrogen. It can be demonstrated, however, that the selenium procedure produces positional isomers whereas the oxides of nitrogen method produces a homogeneous elaidic acid.

CORROSION OF ALUMINUM IN HIGH TEMPERATURE WATER. By D. F. Maclennan, Naval Research Establishment. (Read March 14, 1960). A number of aluminum alloys have been corroded, in high purity water, at 300°C for short periods of time. The corrosion products have been examined by means of optical microscopy and electron microscopy. Results show that corrosion resistance is associated with the distribution of second phase particles in the alloys. The alloy, which has the best corrosion resistance, contains the most uniform distribution of cathodic second phase particles, and the corrosion product film of this alloy contains a corresponding distribution of irregularities. It is suggested that the second phase particles modify the film in such a way as to increase its protective qualities.

SEMICONDUCTOR PROPERTIES OF SOME NATURAL SULPHIDES. By G. A. Collins, Nova Scotia Technical College. (Read March 14, 1960). A study has been made of the semiconductor properties of naturally occurring sulphides. Specifically the conductivity, thermoelectric power and Hall coefficient have been measured of pyrite, chalcopyrite, galena, acanthite-argentite, chalcocite and covellite. All observations can be quantitatively accounted for by modified presently accepted semiconductor theory.

Auxiliary investigations have shown that the thermoelectric voltage of a sulphide is a function of maximum temperature of annealing or formation and sulphur pressure of the environment of formation or annealing. The silver content of galena is indicated by the magnitude of a positive thermoelectric voltage or positive Hall mobility. Non-argentiferous galena is a n-type semoconductor.

The Hall mobility has been found to be an excellent indicator of the environmental history of a sulphide specimen.

BACTERIAL EFFECT AND RADIOPHOSPHORUS ASSIMILATION IN ORGANIC AND INORGANIC STATES IN SALMON. By P. N. Srivastava, Dalhousie University. (Read March 14, 1960). The effect of bacteria on radiophosphorus metabolism in yearling salmon was studied. In the first set of experiments two groups of fishes were maintained. To one the antibiotic tetracycline was added so that the P^{32} put in them remained in inorganic form because of the inactivation of bacteria. In the other group, which served as control, three-fifth of P^{32} was either ingested or transformed into organic form by the bacteria. In the treated set the percentage of radiophosphorus absorbed was 39.6 whereas in control it was only 27.5. The turnover time for water and fish came to 116.1 hours and 54.7 hours in treated and 142.2 and 71.4 hours in control respectively.

In another set of experiments fishes were kept in different aquaria containing P^{32} in exclusively organic and inorganic forms. Fishes kept with inorganic radophosphorus could utilize phosphorus more easily and rapidly than the fish maintained in organic P^{32}. In 144 hours fish could absorb only 24.5 per cent of radiophosphorus in organic form whereas in inorganic state they utilized 43.0 per cent. The turnover time for water and fish came to 156.0 hours and 82.6 hours for fishes maintained in organic P^{32} and 107.5 and 51.8 hours for fish kept in inorganic P^{32}.

The conclusion arrived at is that fishes have a tendency to absorb selectively inorganic salt from water which supports the assumption of Krough (1937, 1939). But at the same time if they are forced to remain with salts in organic form, they can assimilate the salts but the rate and amount of assimilation are very much reduced.

ACTIVITY OF JUVENILE CHUM SALMON (Oncorhynchus Keta) DURING ADAPTION TO SEA WATER. By A. H. Houston, Dalhousie University. (Read April 11, 1960). Transfer from fresh water into sea water produced an immediate and marked depression in the cruising speed of juvenile chum salmon. Despite considerable recovery from this initial effect the fish exhibited a continuing, but much smaller depression in cruising speed over the entire experimental period (80 hours). Variations in total body levels of chloride and water were significantly correlated with variations in cruising speed, suggesting a relationship between activity and the process of osmoregulatory adaption to sea water. Possible mechanisms underlying this effect are discussed.

The Economics of Anaerobic Yeast Growth. By J. G. Kaplan, Dalhousie University. (Read April 11, 1960). Monod and Hinshelwood have shown that the final mass of bacteria yielded in a growth experiment is directly proportionl to the concentration of carbon source in the medium. The stoichiometric relation between energy source and protoplasm can be expressed as a molar growth yield (MGY: mg. protoplasm/mM. substrate). The work of Werkman and of Bauchop and Elsden suggests that the stoichiometry might rather be between growth and number of moles of ATP formed per mole of substrate fermented (by several species of bacteria using various pathways of fermentation). I have determined the MGY for aerobically and anaerobically grown yeast to see if such a relation exists; in addition to measuring glucose consumption in the medium, determinations of intracellular carbohydrate were performed in case a large oxidative assimilation of glucose were occurring in the aerobic cells. MGY values of aerobic cells were four times higher than for anaerobic cells. However, the net yield of ATP per mole glucose dissimilated is approximately 20 times higher for the aerobic than for the anaerobic yeast. Thus from the energetic point of view, the growth of anaerobic yeast would appear an astonishingly economic process.

On the Relations of Peridotite and Dunite of Table Mountain, Western Newfoundland. By D. Hope-Simpson, Saint Mary's University. (Read April 11, 1960). The Table Mountain pluton is nearly midway up the west coast of Newfoundland, just south of the entrance to Bonne Bay.

The topographic features of the region include a summit peneplain surface at about 2200 feet elevation; deeply incised V-shaped and U-shaped valleys; cirques, fiords and finger lakes; and a post-glacial beach raised 100 feet above the present mean sea-level.

The crystalline massif of the Long Range trends north-east parallel to the west coast for 140 miles. From Bonne Bay south for 80 miles there is a broad re-entrant in the Long Range mountain front. A section perpendicular to the coast at that latitude shows the gneisses and schists of the Long Range faulted against Cambrian sediments. Westward in stratigraphic succession are limestones and dolomites overlain by clastic sediments of the Humber Arm group all of Ordovician age. In the upper part of the Humber Arm group, volcanic rocks abound, and these are intruded by the ultra-basic and gabbroic intrusions of the Bay of Islands complex. A thickness of from three to five miles of Cambro-Ordovician sediments and volcanics are intruded by sheets that individually may exceed five miles in thickness.

The Bay of Islands complex is a peridotite-dunite-pyroxenite-gabbro complex that outcrops in four major and several minor detached plutons in a belt sixty miles long and ten miles wide. The Table Mountain pluton is the northernmost.

The plutons are banded subparallel to their floors and in this resemble banded gabbro-peridotite plutons in other parts of the world. Some usual features of compositional variation seem to be lacking so that hypotheses of origin often suggested elsewhere scarcely seem applicable. The objective of the study, of which this paper is a progress report, is to study the zones of contorted banding where the relation of dunite to the banding is clearest in order to throw light on that problem.

The Soluble Collagen of Cod. By E. G. Young and J. W. Lorimer, Atlantic Regional Laboratory. (Read May 9, 1960). A comparison has been made of the collagen extractable at 4° with citrate buffer of pH 3.4 from the skin and the swim bladder of the Atlantic cod. The collagen was recovered as needle-like fibrils, about 50 x 0.6 μ, with characteristic transverse bands. The collagens from skin and swim bladder contained respectively 18.2 and 18.4% N, 8.0 and 8.4% hydroxyproline, 0.06 and 0.12% hexosamine. The distribution of amino acids was quantitatively identical. Some physical constants determined were $[\alpha]^{5}_{D} - 349 \pm 50^{\circ}$, $s^{\circ}_{-20,w}$ 3.17 ± 0.10 S, $[\eta]$ 12.8 ± 0.3, mol. wgt. 280,000 ±20,000 for skin collagen; and $[\alpha]^{5^{\circ}}_{D} - 385 \pm 6^{\circ}$, $s^{\circ}_{-20,w}$ 4.03 ± 0.05 S, $[\eta]$ 17.2 ± 0.1, mol. wgt. 480,000 for collagen from swim bladder. The two collagens thus appear to be very similar, if not identical, chemically but differ in their physical properties.

Utilization of Calcium and Iron by the Rat During Administration of Ethylenedieminetetraacetate.By W. W. Hawkins and B. A. Larson, Atlantic Regional Laboratory, (Read May 9, 1960). Young rats were divided into five groups, and disodium ethylenediaminetetraacetate (EDTA) was given to them as follows: 0; 0.5 and 3.0 mg. per day intraperitoneally; 0.3 and 1.5% in the diet. The basal diet in the amounts eaten supplied each animal with 140-210 mg. of calcium and 3-5 mg. of iron per day. The diets to which it was added supplied 30-45 and 150-225 mg. of EDTA per rat per day.

After 110 days calcium was determined in 24-hr. outputs of urine and faeces, and in the blood serum and the right femur. Iron was determined in the blood serum, and the liver and spleen.

The rate of growth, relative weights of femur, liver, and spleen, the excretion of calcium, and its concentration in serum and femur did not differ among the various groups of animals.

The intraperitoneal injection of EDTA did not affect the concentration of iron in the blood serum, but its presence in the diet at both levels was associated with concentrations of iron in the serum about 40% higher than those in the other groups. The concentration of iron in the liver was different in only the groups fed the larger amount of EDTA, where it was reduced by about 65%. The intraperitoneal injection of the larger amount of EDTA and its ingestion at both levels were associated with decreases in the concentration of iron in the spleen, the average levels being 20-40% below that in the control animals.

It is noteworthy that these amounts of EDTA had no apparent effect upon calcium metabolism. It is known that under similar conditions the urinary excretion of iron is increased. Apparently this occurs in conjunction with depletion of iron stores, the level in blood serum being high because of its intermediary role.

Some Metabolites of Fluoroacetic acid in Yeast Cells. By J. G. Aldous, Dalhousie University. (Read May 9, 1960). Resting suspensions of yeast cells exposed for 30 minutes at pH 2.2 to 5 x 10^{13} M monofluoroacetic acid present many of the signs of fluorocitrate poisoning, i.e., reduced ability to oxidize acetate or glucose, accumulation of citric acid, etc.

Extracts of the metabolite of fluoroacetate were found to be toxic in rats and to give rise to citric acid accumulation in the heart, liver and kidney. The toxic principles were finally isolated and partially separated by silicic acid chromatography. Two of the three fluorine-containing materials were fatty acids, provisionally identified as fluoro-butyric and fluoro-hexanoic acids, and the third substance proved to be a small amount of unmetabolized fluoroacetic acid.

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PROCEEDINGS

OF THE

Nova Scotian Institute of Science

HALIFAX, NOVA SCOTIA

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Printed for the Institute by Rolph-Clark-Stone, Maritimes, Limited
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PROCEEDINGS
OF THE
Nova Scotian Institute of Science

VOL. 25 - PART 3

LAND MOLLUSCA IN THE VICINITY OF WOLFVILLE, NOVA SCOTIA

R. G. Moore

Department of Geology, Acadia University, Wolfville, Nova Scotia

(Received for Publication, March 13, 1962)

ABSTRACT

The geographical and ecological distribution of twenty-five species of terrestrial mollusks in the vicinity of Wolfville, Nova Scotia is described. Local paucity of gastropods, as compared with the Nova Scotian total, is related to the low lime availability of the A subzone of the soils. Two new records for the province are indicated: *Quickella vagans* and *Vertigo bollesiana.* In addition, seven new records are added to the Nova Scotian mainland total.

INTRODUCTION

The two principal aims of this study have been to determine the land molluscan fauna in the vicinity of Wolfville and to provide local distributional and ecological data for the species present. A significant byproduct of the investigation has been to establish two new records for the province — *Vertigo bollesiana* and *Quickella vagans.* To achieve these ends, collections of land snails were made at intervals during the spring and fall of 1961. All but one of the twenty habitats sampled lie within a ten mile radius of Wolfville (see locality map). At each station, the microhabitat of each species and the dominant vegetation type were recorded. The data obtained has been assembled in the sections of this paper dealing with gastropod localities and habitats.

LITERATURE REVIEW

The first list of Nova Scotian shells was published in 1857 in the Church Times at Halifax. Compiled by John Robert

Willis, it gave an alphabetical listing of generic and specific names only. Willis' latest and longest list appeared in 1863, was privately printed but fortunately reprinted in the Nova Scotia Institute of Science Proceedings and Transactions (Ganong, 1890). Fourteen terrestrial species were included and these were arranged phylogenetically. Most of the specimens were apparently collected in the vicinity of Halifax and Dartmouth.

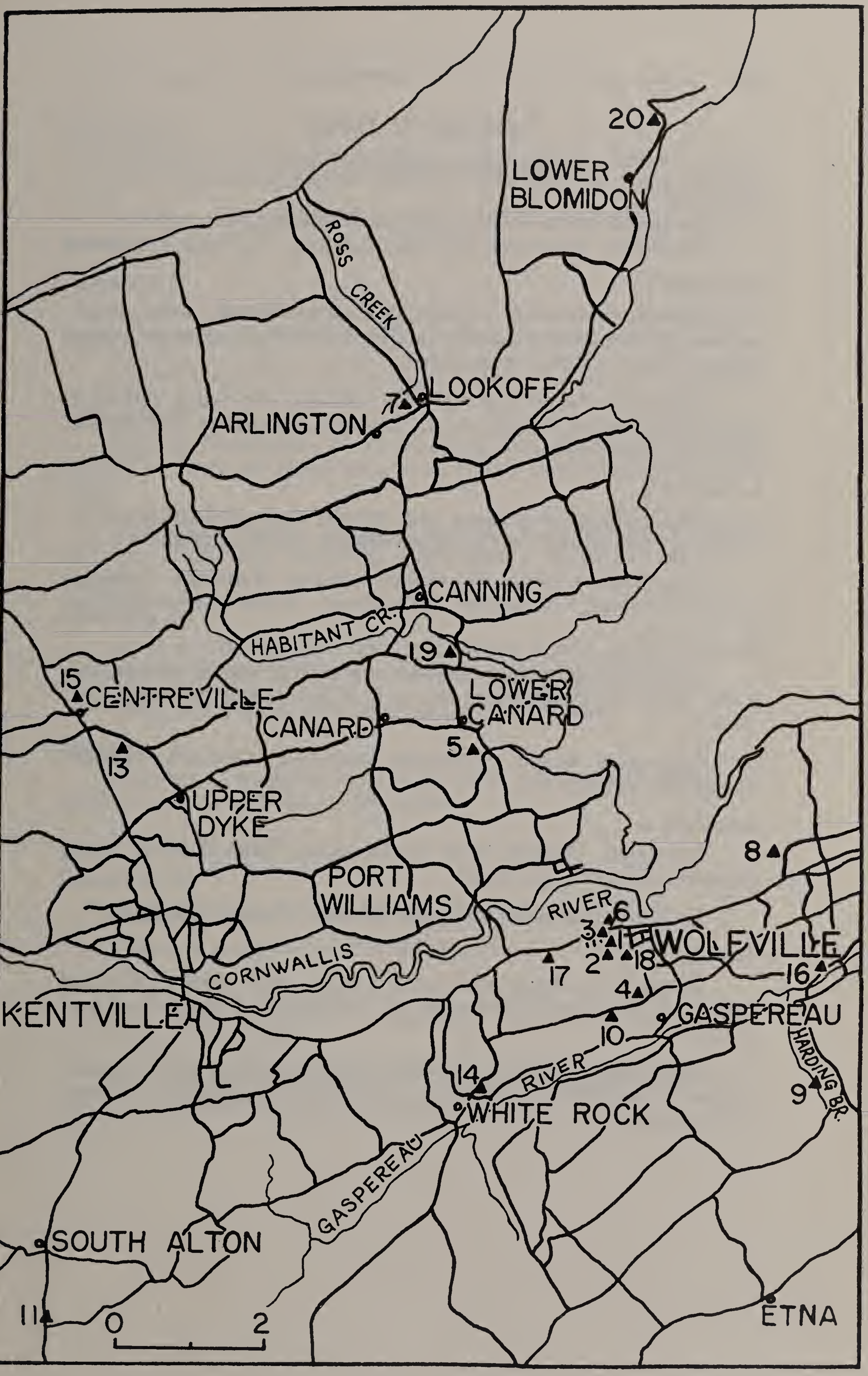
Jones (1877), in the same Proceedings and Transactions, also had published a record of the Nova Scotia mollusca. This, as far as the terrestrial gastropods are concerned, was the same as Willis' except for certain nomenclatorial changes, possibly one change in identification ie. *Helix hortensis* for *H. nemoralis* and one addition *H. pulchella.* These species are *Cepaea hortensis*, *C. nemoralis*, and *Vallonia pulchella* in current nomenclature.

In 1906, Campbell published a list of the mollusks of Pictou county. This included ten terrestrial species of which three were new records: *Retinella indentata*, *Triodopsis albolabris*, and *Pallifera dorsalis* (recent nomenclature). The last two records need yet to be confirmed; the first, if not based on a misidentification has now been confirmed.

Further additions to the Nova Scotian terrestrial gastropod record were not made until 1949 when Ord and Watts published a paper on the slugs of the province. If Campbell's list is accurate, two rather than four new records (as reported) were added at this time.

MacMillan (1955) who made a survey of the Cape Breton land and freshwater gastropods, has added thirteen species to the provincial list, the largest number since Willis' time. Excluding subspecies, forty species were reported by him for the island as compared with the twenty-nine, currently known for the mainland.

Twenty-five species have been listed for the Wolfville area. This may be compared with forty-two for Cape Breton (MacMillan, 1955), twenty-seven for New Brunswick (LaRocque, 1961) and sixty-five for Maine (Johnson, 1915). The low figure for New Brunswick can certainly be ascribed to insufficient collecting.


20
LOWER BLOMIDON
ROSS CREEK
7
LOOKOFF
ARLINGTON
CANNING
HABITANT CR.
19
15
CENTREVILLE
LOWER CANARD
CANARD
5
13
UPPER DYKE
PORT WILLIAMS
8
RIVER
6
3
1
WOLFVILLE
2
18
17
16
CORNWALLIS
4
KENTVILLE
10
GASPEREAU
HARDING BR.
RIVER
14
9
WHITE ROCK
GASPEREAU
SOUTH ALTON
11
0
2
ETNA

LOCALITY DATA

(refer also to locality map)

Locality 1

backyard lawn, 4 Park Street, Wolfville

Zonitoides arboreus, Cionella lubrica, Vallonia excentrica

Locality 2

narrow floodplain bordering College brook, near intersection of projected extension of Highland Park avenue; young aspens, some willows and alders.

Hygromia hispida, Zonitoides nitidus, Oxychilus cellarius, Retinella electrina, Succinea sp. (1 shell), *Deroceras reticulatum, Arion circumscriptus*

Locality 3

floodplain with grasses and weeds, near embankment on west side of College brook, immediately north of highway 1

Hygromia hispida, Zonitoides nitidus, Retinella electrina, Cionella lubrica, Deroceras reticulatum, Arion circumscriptus

Locality 4

upland with second growth trembling aspen woods, .25 miles west of Highland avenue on Ridge north of Gaspereau valley

Zoogenetes harpa, Retinella electrina, Cionella lubrica, Vertigo bollesiana

Locality 5

dykeland, Canard river north shore, west side of road; grasses dominant (no trees)

Vallonia pulchella, Cionella lubrica, Vertigo pygmaea

Locality 6

floodplain with grasses and weeds, west side of College brook, a few yards upstream of Dominion Atlantic railway track

Zonitoides nitidus, Retinella electrina, Vitrina limpida, Discus cronkhitei catskillensis, Deroceras reticulatum, Arion circumscriptus

Locality 7

upland, second growth mixed deciduous-coniferous woods, .2 miles west, on Arlington road, of west road to Bennett Bay

Vertigo gouldi, Cepaea hortensis, Discus cronkhitei catskillensis

Locality 8

marshy, hummocky, non-wooded ground, west side of road, first west of Grand Pre park; just south of railway track.

Cionella lubrica, Retinella electrina, Vallonia excentrica

Locality 9

narrow floodplain of Harding brook, about 1 mile upstream of store at Melanson, with mixed hemlock, spruce and birch

Euconulus fulvus, Discus cronkhitei catskillensis, Cionella lubrica, Zonitoides arboreus, Retinella indentata, Striatura exigua

Locality 10

upland with mature hemlock-spruce forest, about 1 mile west of Highland avenue on Gaspereau Ridge road

Vertigo gouldi paradoxa, Zonitoides arboreus

Locality 11

outcrop of amygdaloidal basic rock, east side of highway, about 1 mile south of South Alton

Vertigo pygmaea

Locality 12

edge of house, 4 Park Street, Wolfville

Vallonia excentrica, Cionella lubrica

Locality 13

dominantly coniferous woods, 1 mile from Centreville, on Upper Dyke road

Euconulus fulvus, Discus cronkhitei catskillensis, Striatura exigua, Zonitoides arboreus, Vertigo ventricosa

Locality 14

upland with second growth deciduous woods, about .5 miles from White Rock on road to Gaspereau Ridge road

Striatura exigua, *Discus cronkhitei catskillensis*, *Succinea sp.* (shell only)

Locality 15

wet, young deciduous woods, adjacent to bog in Centreville

Striatura exigua, *Discus cronkhitei catskillensis*, *Quickella vagans*

Locality 16

floodplain of Gaspereau river, north slope, west side of road at bridge to Wallbrook; marshy plants

Succinea sp.

Locality 17

road embankment, grass and weed covered, bordering brook; about .7 miles east of Greenwich on south side of highway 1

Hygromia hispida, *Cionella lubrica*, *Zonitoides nitidus*, *Oxyloma decampi gouldi*, *Deroceras laeve*, *Deroceras reticulatum*, *Arion circumstriptus*

Locality 18

old foundation, east side of University avenue, about .1 mile south of Highland Park avenue, Wolfville, Nova Scotia.

Hygromia hispida, *Zonitoides nitidus*, *Cionella lubrica*, *Oxychilus cellarius*, *Deroceras reticulatum*, *Arion circumscriptus*

Locality 19

small brook with marshy vegetation, flowing into Habitant Creek just west of the first north-south road east of Canning

Oxyloma decampi gouldi

Locality 20

cow pasture, bordering roadway trending northwest from Lyons Cove, about 1 mile north of Lower Blomidon

Arion subfuscus, *Arion circumscriptus*, *Vitrina limpida*, *Cionella lubrica*, *Vallonia excentrica*, *Discus cronkhitei catskillensis.*

The most ubiquitous species of land snail in the vicinity of Wolfville appears to be *Cionella lubrica* which has been found at 50% of the localities. *Discus cronkhitei catskillensis*, noted at 35%, comes a poor second.

Whereas several species have been found at single localities, ie. *Quickella vagans*, *Zoogenetes harpa*, *Vertigo ventricosa*, *Arion subfuscus*, *Vertigo bollesiana* and *Retinella indentata*, the last two are known by single specimens only. These would seem to be the most selective in their habitat preferences or the least adaptable.

The most varied fauna observed was found at locality two. It comprised eight species. The most restricted molluscan faunas were recorded at localities eleven and sixteen. Each contained a single species.

ECOLOGICAL DATA

Family Succineidae

Oxyloma decampi gouldi Pilsbry

in grass, under matte, on wet brook embankment
on rushes partly submerged in water of brook

Quickella vagans (Pilsbry)

in and under wet leaf mould, deciduous woods, adjacent to bog

Family Cionellidae

Cionella lubrica (Mueller)

under rocks and boards in lawn
in grass on stream embankment
on bone fragment in second growth aspen woods
on drift wood and boards in meadow bordering brook
under wood in marshy ground
under started bark and rotting logs, mixed coniferous woods, floodplain of brook
under boards and logs, in cow pasture bordering road
under boards, bones, by old foundation

Family Pupillidae

Vertigo bollesiana (Morse)

under started bark, second growth *Aspen* woods

Vertigo gouldi (Binney)

under started bark, second growth mixed coniferous-deciduous woods (poplar, birch, spruce)

Vertigo gouldi paradoxa Sterki
under started bark, mature hemlock-spruce forest

Vertigo pygmaea (Drap.)
in grass and weeds, under boards and logs, floodplain of creek
in crevices, on basic amygdaloidal flow rock

Vertigo ventricosa (Morse)
under boards, mainly coniferous woods

Family Valloniidae

Vallonia excentrica Sterki
under boards and rocks in lawn grass
on cut wood, in grasses on boggy ground
under boards and bogs, along roadway in cow pasture

Vallonia pulchella (Mueller)
under boards and logs in grass on floodplain

Zoogenetes harpa (Say)
on pieces of wood, some burnt, second growth *Aspen* woods

Family Endodontidae

Discus cronkhitei catskillensis (Pilsbry)
on damp cardboard in grass and weeds, brook floodplain
on damp paper, second growth mixed coniferous-deciduous woods
on rotten logs, mixed birch, spruce, hemlock woods, narrow floodplain of brook
started bark, mainly coniferous woods
under logs, second growth decidious woods
in leaf mould, young deciduous woods, adjacent to bog
under boards, cow pasture, adjacent to roadway

Family Zonitidae

Oxychilus cellarius (Mueller)
in leaf mould and under rotting logs, flood plain of brook
under boards and bones, in grass and weeds, at old foundation

Retinella electrina (Gould)

in leaf mould, under branches and logs, floodplain of brook
on bone fragment, second growth *Aspen* woods
on damp cardboard in grass and weeds, floodplain of brook
on cut wood, in grass, boggy ground

Retinella indentata (Say)

on rotten logs, hemlock-spruce-birch woods, narrow floodplain of brook

Striatura exigua (Stimp.)

under rotten logs, hemlock-spruce-birch woods, narrow floodplain of brook
rotten logs, mainly coniferous woods
under logs and in leaf mould, second growth deciduous woods
in wet leaf mould, deciduous woods, adjacent to bog

Vitrina limpida Gould

on damp cardboard, in grass and weeds, floodplain of brook
under boards and logs, in cow pasture, adjacent to roadway

Zonitoides arboreus (Say)

under boards and stones in lawn grass
under started bark, hemlock-spruce-birch woods, on narrow floodplain of brook
under started bark of logs, upland mature hemlock-spruce woods
in grass and leaf mould, road embankment bordering brook

Zonitoides nitidus (Mueller)

in leaf mould, under branches and logs, *Aspen* woods, floodplain of brook
under boards and logs, in leaf mould bordering brook
on damp cardboard, in grass and weeds, floodplain of brook

Family Arionidae

Arion circumscriptus Johnston

under boards and logs in cow pasture next to roadway
in damp leaf mould, grassy and weedy road embankment bordering brook
under boards, in grasses and weeds by old foundation

Arion subfuscus (Drap.)

under boards and logs in cow pasture next to roadway

Family Limacidae

Deroceras laeve (Mueller)

in damp leaf mould, grassy and weedy road embankment bordering brook

Deroceras reticulatum (Mueller)

under boards in weeds and grasses next to old foundation

in damp leaf mould, grassy and weedy road embankment bordering brook

Family Kaliellidae

Euconulus fulvus (Mueller)

under rotting logs, mainly coniferous woods (upland)

under rotting logs, hemlock-spruce-birch woods, floodplain of brook

Family Helicidae

Hygromia hispida (Linne)

in leaf mould and under logs, *Aspen* woods on floodplain of brook

in leaf mould and under boards, in grasses and weeds on floodplain of brook

in leaf mould, grassy and weedy embankment bordering brook

under boards, in grasses and weeds, by old foundation

Cepaea hortensis (Mueller)

on damp cardboard, second growth mixed deciduous-coniferous woods (upland)

ECOLOGICAL DISCUSSION

The presence or absence of an organism is to a considerable extent dependent upon environmental factors. Now while these are to varying degrees interrelated, some factors appear to be more restrictive than others. In the case of terrestrial mollusks in Britain, Boycott (1934) noted that local distribution could be directly correlated with available moisture, shelter and lime. Further, food per se, had no influence either by its quality or quantity on the recurrence of the gastropods. Snails usually feed on decaying vegetation and fungi, few feed directly on living plants but some are carnivorous. The type of plant cover supplying the decaying matter is immaterial except for the effects it has on the physical nature of the habitat ie. acidity, shelter, moisture retention and percentage of organic matter.

As noted previously, over forty species of terrestrial mollusks have been reported from Nova Scotia but only twenty-five in the vicinity of Wolfville. This difference cannot be entirely attributed to insufficient or inadequate collecting nor to major climatic differences within the province. A fairly wide range of habitat types has been examined. Further, a number of the larger, more conspicuous species have not been observed locally ie. polygyrids, anguispirids, etc. More likely it is due to the low lime content in the A subzone of the Wolfville area soils. To test this postulate, I intend to make a study of the land mollusks of the Windsor area, a region in part underlain by limestone, gypsum, and anhydrite.

Graham (1957) in his study of the molluscan skin has emphasized the fact that no mollusk has become truly terrestrial in the sense that an arthropod or vertebrate is terrestrial, even though many gastropods live on land. Thus gastropods are terrestrial in the sense that woodlice and *Peripatus* are terrestrial. They avoid the truly terrestrial conditions and live in restricted habitats of high humidity. They have never acquired the water-proof skin which true land life requires — either by covering the epidermis with a waterproof cuticle (as in insects) or by covering it with layers of dead cells or scales (as in vertebrates).

That moisture is important is readily apparent when we consider our local situation. I found the largest number of individuals per species and species per habitat in damp localities ie. floodplains. Locally these exhibited different dominant vegetation types, for example grasses and weeds vs. mixed deciduous woods. The amount of moisture required does vary considerably from species to species however. Thus *Zonitoides nitidus* has been found only in rather moist situations but *Vertigo pygmaea* appears able to thrive equally well in wet and dry localities. The latter species because of its small size, was afforded shelter by minute crevices and solution cavities in bare amygdaloidal basic flow rock near South Alton.

Even a combination of good moisture and shelter may not be sufficient for many species, however. Thus the fairly mature hemlock-spruce woods at locality ten, which had a good ground cover of matte and rotting logs and also a good moisture content, revealed few individuals of only two species after diligent search. The very low lime content of the soil and its high acidity made this area unfavourable to abundant molluscan life.

Finally, the importance of man should not be overlooked in connexion with snail ecology. His clearing of the land and cultivation tends to reduce soil moisture in summer and at the same time remove habitat niches. On the other hand, he may increase the lime content of the soil through fertilization thereby making it suitable for some species.

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97th ANNUAL MEETING

PRESIDENTIAL ADDRESS

J. R. Dingle

October 17, 1960

During the year now closing we have learned with sorrow of the deaths of three of our members of long standing. Dr. V. O. Mader, for many years well-known as a physician and surgeon in Halifax, passed away on October 25th, 1959. Dr. H. R. Chipman died in Halifax on February 7th, 1960. Dr. Chipman was elected a life member of the Institute in October 1921, and for a number of years served the Institute faithfully as Editor and Councillor. He had served on the staff of the Halifax Station of the Fisheries Research Board, and then as a teacher of chemistry at Queen Elizabeth High School until his retirement about two years ago. His genial and witty personality won for him many friends. On May 14th, 1960 we lost Dr. E. F. Whyte, a native of Truro who had lived in Halifax since 1924. Dr. Whyte was for a time principal at Louisbourg Academy, and then joined the Food and Drug Division of the federal Department of Health, retiring as its Regional Director. He received the Queen's Coronation Medal for these services.

In addition to the annual business meeting, the Institute held 7 ordinary meetings, including one jointly with the Valley Chapter, and 2 extraordinary meetings. The ordinary meeting scheduled for November had to be cancelled because of a lack of papers. The 18 papers read at the ordinary meetings can be classified according the subject and institution of origin as follows:

Chemistry	4	Dalhousie, Medical Science	3
Biochemistry	5	Dalhousie, Biology	3
Biology	3	National Research Council	6
Bacteriology	1	Naval Research Establishment	1
Physiology	3	Fisheries Research Board	3
Physics	1	Saint Mary's University	1
Geology	1	Nova Scotia Technical College	1

The extraordinary meetings were addressed by Dr. Edwin A. Dawes, of the University of Glasgow on "Some Aspects of the Metabolism of Zymosarcina Ventriculi", and by Dr. J. Tuzo Wilson of the University of Toronto, on "Mountain

Building and the Physical Behavior of the Earth". Average attendance at the various meetings was 35, with extremes of 23 and 60.

The total membership of the Institute is roughly unchanged from last year, and stands at 301. During the year, 21 new members were proposed.

The Institute again held an essay contest but only 3 entries were received, all from one institution. In the opinion of the judges, none of these merited a prize, and accordingly none was awarded.

There has been a considerable delay in the publication of the Institute's Proceedings, and they are now 3 issues in arrears. One issue is, however, in the hands of the printers. We have two rather lengthy papers in the offing; preliminary manuscripts have been received, and the final drafts are promised for this month and late December respectively. We hope, if our finances will permit, to use these two papers as the bases for the other two issues that should be published as soon as possible. These plans, if carried out, will undoubtedly exhaust our financial resources. We were unsuccessful in obtaining an additional provincial grant of $500 last year, but it is now obvious that the annual grant will have to be raised to at least $750 if we are to continue such publications. The annual grant has stood at $500 from time immemorial.

Professor H. S. Heaps has now served the Institute as Secretary faithfully and efficiently for 5 years, and I am happy to announce that the Council has awarded him a Life Membership. Dr. A. D. MacDonald has left Halifax for California, and hence we must do without his valuable advice on the Council. I should like to record my conviction that the Institute is much poorer for this loss.

Upon the whole, the past year leaves not a little to be desired. The essay contest was a failure, but I feel that this was due to a lack of interest on the part of the students rather than to poor publicity on the part of the Institute. It has been said that it might be better to suggest specific titles for the essays so as to guide the students to some extent, and perhaps this remedy should be tried before burying the contest altogether. Much more serious than this is a continued apparent lack of interest and activity among the members themselves. As I mentioned last year, the number of papers presented seems too small for a membership of approximately 200 in the Halifax area. Furthermore, certain sections of our scientific community are not contributing at all, and, as I have said, it was necessary to cancel one of the regular meetings because of lack of papers. We had no student contributors last year, in spite of the valuable experience that they could obtain in this way. It may be that it is impossible for them to prepare and present talks during the Institute's season, but I would urge their professors to consider this matter again.

In spite of what I have just said, it appears that the majority of members feel that the Institute can best serve the needs of the scientific community by continuing its present form of meetings. It can in this way encourage a periodic communication among the various groups involved and discourage the fragmentation of our community into self-centered and even self-righteous splinters.

I feel that the time has come to inject some new blood into the Council of the Institute, and the several retirements that occur this year will make this easier to do. There is a considerable roster of relative newcomers with ideas and a considerable store of enthusiasm. This reservoir should be tapped, and I will venture to say that in doing so, first consideration should be given to ability of the individual rather than to representation of institutions. While I suppose that there is a certain amount of honour associated with membership in the Council, I think most of us will agree that this should be very much a secondary consideration in accepting such a post.

The present business meeting is the 97th of the Institute, which was founded on December 31st, 1862. It is generally agreed that the session to begin one year from now should be marked as our 100th anniversary. For several years there has been talk about some special event to mark this milestone, but the suggestions have been vague. In going over some old literature, I was surprised to find that the Institute held popular exhibitions in 1926 and 1928. The latter one was particularly impressive and the catalogue of exhibits shows that a tremendous amount of work was involved. Public response was said to be excellent. I suggest that the time has come for another such exhibition. Undoubtedly, you can think of many reasons for undertaking such an expenditure of energy, not the least of which would be a rekindling of interest in the various sciences among the high school students. This sort of thing is perhaps the province of the Museum of Science, but as Dr. Weld mentioned in his Presidential Address of 1949, our Institute, the Museum, and the Research Foundation form a related trio. Then let them work together to commemorate the 100th Anniversary.

In connection with the matter of communication among members of our scientific community, I should like to mention briefly a matter that has been in the minds of some of our members. We have in this area government research laboratories and institutions of learning. The former are primarily intended to assist local industries and the development of the Atlantic region generally. Much of their work must necessarily be in the applied field, but this has to be based on so-called fundamental knowledge. Someone must produce the latter. There is much discussion over the proper division of this work between the two types of institutions I have mentioned. Most will agree that universities should be concerned only with the acquisition of fundamental knowledge, but some hold that only they should be so concerned. The principal answer to that stand is that the universities — at present at least — simply have not the facilities to deal with the large number of "fundamental" problems requiring solution, and the government research services are forced to do most of it in order to keep their applied work in a healthy position. The thought I wish to leave with you is this: university professors could help a great deal if they would familiarize themselves with the work going on in the government laboratories, and then design their own research programs so as to deal with some of the really basic problems which these institutions cannot deal with, but which conceivably could be useful in the future.

Gentlemen, I should like to record my thanks to the officers and Councillors who did so much to carry on the affairs of the Institute, and to you for having entrusted to me the office of President, and bearing with me for the past two years.

PROCEEDINGS OF MEETINGS

Session of 1960 - 1961

(Meetings were held in the Medical Sciences Building, Dalhousie University, the Sir James Dunn Science Building, Dalhousie University, and Elliott Hall, Acadia University.)

99th Annual Business Meeting: October 17, 1960

The meeting was presided over by the President, Dr. J. R. Dingle. His address appears on page 199 of the Proceedings. The Officers presented their reports.

The Treasurer, C. R. Masson, reported:

Receipts	$1,452.70
Expenditures	427.70
Invested Funds	500.00
Bank balance, October 1960	1,908.36

The Librarian, Miss E. M. Campbell, reported:

The Proceedings of the Institute have been put on microfilm and a notice to this effect will be included with the next issue. These notices will go to all the exchange societies and they may order the microfilm from the Canadian Library Association in Ottawa, which has the master negative and will arrange to have copies made. The positive copy is in the Institute's Library.

Extra copies of the Proceedings are now together with the exception of volumes 1—9, are available in considerable numbers. Almost 100 copies have been found of issues that are of great interest, containing Roland's *Flora of Nova Scotia* and *Marine Fishes of Nova Scotia* by Vladakov and MacKenzie.

The checking is still continuing of the exchanges and the list is being brought up to date. The first supplement of the *Union List of Scientific Serials in Canadian Libraries* has just been released and it contains more entires of the Institute's holdings. The third supplement of the American scientific list is now being prepared and we are checking for listing in that.

The usual work of the library is carried on including binding and interlibrary requesting of the journals. Considerably more lending of the Institute's holdings has taken place since the journals have been listed in the various list of periodicals have been published.

There has been an increase in the correspondence in the last year. Many of these letters have dealt with the exchanges and missing numbers have been sent when available. There were a great many queries about the next issue of the Proceedings and these were answered. In addition there have been requests for historical information from people whose relatives were once members of the Institute, and from individuals and institutions asking for information on seaweed, insects, etc. These have received replies or the letter has been passed on to other institutions who have more information on the subject.

All correspondence is kept on file and is available to the members.

Officers elected for the year 1960-61 *were*:

President	Dr. W. J. Archibald
First Vice-President	Dr. J. A. McCarter
Second Vice-President	Dr. C. R. Masson
Secretary	Dr. W. Yaphe
Treasurer	Dr. C. R. Masson
Editor	Mr. H. S. Heaps
Council	Dr. E. H. Anthony Mr. E. L. Cameron, Dr. J. R. Greenblatt, Dr. J. G. Retallack, Dr. J. E. Stewart
Auditors	Dr. H. L. Bronson Dr. A. E. Cameron

New Members:

During the year the following new members were proposed and were elected by Council, Ordinary: N. J. Campbell, R. W. Trites, R. W. Stewart, O. D. Kennedy, G. P. Arsenault, H. J. Brown, S. J. Patrick, Doris I. Fraser, N. L. Benoitin, J. S. Craigie, A. Waddell, W. Skinners, P. M. Jangoord, Dr. J. N. Mehnshi, G. Hutton, N. S. Isaacs.

Student Members: W. B. Bailey, Sheila L. Duff, G. H. Green, Lorraine Lawrence, J. M. Pezzata, D. Tsernoglou, R. R. Weiler, R. W. Doyle, Jill E. Garrard, Dorothy P. Geffrey, B. Gail Mallinson, Jean E. Percy.

Extraordinary Meeting, October 20, 1960.

Dr. J. P. Bruce of the Meteorological Headquarters in Toronto addressed the Institute on "Water and Weather".

1*st Ordinary Meeting*: November 14, 1960.

Papers: 1. "The Nutritional Value of the Proteins of Some Seaweeds and Fish Products," by W. W. Hawkins and B. A. Larsen; 2. "Dose and Effect on Epidermal Carcinogenesis," by J. K. Ball and J. A. McCarter; 3. "Corrosion of Aluminum," by A. McMillan.

2*nd Ordinary Meeting*, January 9, 1961.

Papers: 1. "Studies on the Relationship Peripheral Resistance and Stroke Volume in a Circulating System," by W. Josenhans; 2. "Measurement of Low Permeability in Ceramic Test Pieces," by S. G. Whiteway; 3. "Some Biochemical Features of Scallop Muscle Protein," by J. J. Matsumoto.

Extraordinary Meeting, February 8, 1961.

Dr. Anthony S. Laughton of the National Institute of Oceanography, Godalming, Surrey, addressed the Institute on "The Ocean Floor." Dr. Anthony was in Halifax as a Visiting Nuffield Lecturer.

3*rd Ordinary Meeting*, February 13, 1961.

Papers: 1. "The Amino Acid Composition of Cod Tropomyosin," by P. L. Hoogland, H. C. Freeman, Beryl Truscott, and A. E. Waddell; 2. "Interaction Between Ocean Waves and Currents," by R. W. Stewart; 3. "Gravity Measurements in Northern Nova Scotia," by J. E. Blanchard.

4*th Ordinary Meeting*, March 13, 1961.

Papers: 1. "Results of Studies Carried on the Passamaquoddy Power Project," by R. W. Trites; 2. "Ozonolysis of Monoethylenic Fatty Acids," by R. C. Ackman, M. E. Retson, and F. A. Vandenheuvel; 3. "Analysis of Ballistograms by Means of a Circulation Model," by W. Josenhans.

5*th Ordinary Meeting*, April 10, 1961.

Joint Meeting with the Valley Chapter. It was held at 8:15 p.m. in Elliott Hall of Acadia University.

Papers: 1. "Shell-Heap Archeology and some Faunal Problems," by J. S. Erskine; 2. "Time Dependent Wakes," by R. H. Magarvey and R. L. Bishop.

6*th Ordinary Meeting*, May 8, 1961.

Papers: 1. "Phenanthrene, an Anti-Initiating Agent," by T. Y. Huh and J. A. McCarter; 2. "The Appication of Classical Theory to Problems of Enzyme Physiology," by J. G. Kaplan; 3. "Experimental Study of the $Be^9(He^3,n)C$" Reaction", by L. van der Zwan.

Extraordinary Meeting: June 5, 1961.

Dr. Edith E. Townsend of the Graduate Department of Biochemistry, Brandeis University, addressed the Institute on "Studies on Antibodies to DNA."

PROCEEDINGS OF MEETINGS

(Valley Chapter)

Session of 1960-61

The Valley Chapter held seven meetings.

1*st Meeting*, November 7, 1960.

Papers: 1. "Some Parasites and Diseases of the Snowshoe Hare, *Lepus Americanus struthopes* Bangs, in Newfoundland", by D. Dodds; 2. "The Storage of Tomatoes in Artificial Atmospheres", by C. A. Eaves.

2*nd Meeting*, December 5, 1960.

Papers: 1. "The Environment of Molluscs in Sublette County, Wyoming . During Paleocene Time", by R. G. Moore; 2. "The Pheasant in Nova Scotia", by N. Van Nostrand.

3*rd Meeting*, January, 1961.

Papers: 1. "The Role of Disease in the Natural Control of Insects," by R. P. Jacques; 2. "High Altitude Photography of Nova Scotia," by H. L. Cameron.

4*th Meeting*, February 6, 1961.

Papers: 1. "The Strawberry Virus," by D. L. Craig; 2. "To Publish or not to Publish," by C. Eaves.

5*h Meeting*, March 6, 1961.

Papers: 1. "Cytotaxonomy of Lowbush Blueberries in Eastern Canada," by I. V. Hall and L. E. Aalders; 2. "Utilization of Sphagnum Peat Bogs for Crop Production," by D. C. MacKay.

6*th Meeting*, April 10, 1961.

Papers: 1. "Shell-head Archeology and some Faunal Problems," by J. S. Erskine; 2. "Time Dependent Wakes," by R. H. Magarvey and R. L. Bishop.

7*th Meeting*, May 1, 1961.

Papers: 1. "Genetic Studies in Rhizobium," by Joan Doneaster; 2. "A Drop-shape Hypothesis," by R. L. Bishop; 3. "Liquid Surface Impacts," by A. Lau; 4. "Alteration in Two Block River Dykes," by G. W. Roland.

ABSTRACTS

(Papers read before the Institute but not published in the Proceedings).

THE NUTRITIONAL VALUE OF THE PROTEINS OF SOME SEAWEEDS AND FISH PRODUCTS. By W .W. Hawkins and B. A. Larsen, Atlantic Regional Laboratory. (Read November 14, 1960). Standard tests with young rats were applied to investigate the digestibility and the nutritional quality as protein of the nitrogenous constituents of the following materials: dried, alkali-extracted preparations of the seaweeds Chondrus crispus and Laminaria digitata; dried, defatted cod and haddock muscle (fish flour); dried autolystate of cod and haddock stomach and intestines (visceral meal); dried, partly defatted cod liver (liver meal). Egg albumin and casein were used as reference proteins.

From data obtained the following values were calculated; digestibility as the proportion of the ingested nitrogen which was absorbed; protein efficiency ratio, as the gain in body weight associated with the ingestion of a given quantity of nitrogen; biological value, as the proportion of the nitrogen absorbed from digestion which was retained. In these measures of nutritional quality egg albumin is a standard protein of high rank.

The digestibility of the nitrogenous materials of the seaweed preparations was about 70% that of egg albumin. The biological value of the Chondrus crispus preparation was 90% and that of the laminaria digitata preparation 75% that of egg albumin. Their protein efficiency ratios were considerably less than half that of egg albumin.

The digestibility and protein efficiency ratio of fish flour were the same as those egg albumin, and its biological value 90% of the value for egg albumin.

The digestibility of visceral meal was the same as that of egg albumin, and of liver meal 90% that of egg albumin. Their protein efficiency ratios were respectively 12% and 30%, and their biological values 86% and 81% those of egg albumin.

These tests established fish flour as an excellent source of dietary protein. Visceral meal and liver meal were not, mainly because of poor metabolic use of nitrogen absorbed from them. The seaweed preparations were poor sources of dietary protein principally because of their poor digestibility. The metabolic use of the nitrogen absorbed from Chondrus crispus was good, and of that from Laminaria digitata was poor.

DOSE AND EFFECT IN EPIDERMAL CARCINOGENESIS. By J. K. Ball and J. A. McCarter, Dalhousie University. (Read November 14, 1960). Epidermal tumors were produced in the skin of CFW female mice treated with a single application of croton oil. The number of tumors produced per surviving mouse was related directly to the logarithm of the amount of the hydrocarbon that penetrated the skin.

STUDIES ON THE RELATIONSHIP PERIPHERAL RESISTANCE AND STROKE VOLUME IN A CIRCULATION SYSTEM. By W. Josenhans, Dalhousie University. (Read January 9, 1961). When investigating parameters of the human ballistocardiogram, it was found that a sudden change in the peripheral resistance (pressure-flow-ratio) has an equally sudden influence upon the ballistogram. The volume calculated by the Klensch-formula increased when the peripheral resistance dropped, with a delay of about 1 /4 of a second. In order to explain the phenomenon a model experiment was carried out which will be described in more detail. The conclusions are that peripheral resistance directly and immediately changes stroke volume by means of hydrodynamic coupling without involving any biological mechanism.

MEASUREMENT OF LOW PERMEABILITY IN CERAMIC TEST PIECES. By S. G. Whiteway, Atlantic Regional Laboratory (Read January 9, 1961). The apparatus described uses a pressure decline method for measuring the flow of gases through a permeable specimen. The final measurement is a time interval, automatically recorded by an electric timer. The relationship between this timer and the pereability is shown for viscous and molecular flow. The apparatus can be uesd to decide which type of flow is occurring.

SOME BIOCHEMICAL FEATURES OF SCALLOP MUSCLE PROTEINS. By J. J. Matsumoto, Fisheries Experimental Station. (Read January 9, 1961). The biochemistry of the muscle proteins have been attracting the interest of scientists, because these play a dominant role in the activity of muscle of which differ both in structure and in function.

In the present paper, some observations on scallop muscle proteins will be presented.

The proteins of the white adductor muscle of the scallops are more soluble in salt solution of low molarity than the vertebrate muscle proteins, while their extracts show similar behaviour by ultracentrifugal analysis. On the other hand, the scallop proteins differ somewhat from those of some molluscs such as the squid. The distribution of the protein fractions of the mantle muscle of the scallops appears different from those of the adductor muscle.

THE AMINO ACID COMPOSITION OF COD TROPOMYOSIN. By P. L. Hoogland, H. C. Freeman, Beryl Truscott, and A. E. Waddell, Fisheries Experimental Station. (Read February 13, 1961). A purified tropomyosin was prepared from the muscles of Atlantic cod (Gadus callarias). The amino acid composition of this preparation was determined by automatic chromatography. From the results, the number of residues of each amino acid occurring in the tropomyosin molecule was calculated. The obtained values were compared with those reported for other tropomyosins.

INTERACTION BETWEEN OCEAN WAVES AND CURRENTS. By R. W. Stewart, Dalhousie University (Read February 13, 1961). Water waves propagating in regions where the horizontal current speeds are not uniform, are not only refracted, but suffer changes in wave length, wave height and wave energy. This results not only from well known "wave kinematic" effects but from an energy transfer between the waves and the currents.

GRAVITY MEASUREMENTS IN NORTHERN NOVA SCOTIA. By J. E. Blanchard, Dalhousie University. (Read February 13, 1961). Measurements of the earth's gravitational field in Northern Nova Scotia show significant variations which can be attributed, in part, to evaporites deposited in the Mississippian system. Quantitative interpretations of the observations yield much geological information.

RESULTS OF STUDIES CARRIED OUT ON THE PASSAMAQUODDY POWER PROJECT. By R. W. Trites, Atlantic Oceanographic Group. (Read March 13, 1961). In 1956, the International Joint Commission established two Boards to consider the engineering and economic feasibility of the power project and to forecast the effects that these structures would have on the fisheries of the region. The effect of the proposed installation on physical oceanographic conditions is considered here.

The proposed project involves the construction of a series of dams across the mouth of the Passamaquoddy and Cobscook Bays. Passamaquoddy Bay, the proposed high pool, will be filled near high water by 90 filling gates, and Cobscook Bay, the proposed low pool will be emptied near low water by 70 emptying gates. Water will flow from the high pool to the low pool through a 30-turbine powerhouse, generating continuous, but fluctuation power. Oceanographic conditions within the impounded areas will be markedly altered. Tidal ranges and currents will be reduced, while greater seasonal variation in temperature and salinity of the surface layer is anticipated. Outside the dams, only relatively minor changes are expected.

Ozonolysis of Monoethylenic Fatty Acids. By R. G. Ackerman, M. E. Retson, and F. A. Vandenheuvel, Fisheries Technological Station. (Read March 13, 1961). The position of the double bond in ethylenic fatty acids may be determined by oxidative fission and examination of the products. An ozonolysis technique is described giving high product yields, a minimum of secondary oxidation, and total recovery of the dicarboxylic acids. Analyses, using gas-liquid chromatography, require careful selection of column packing materials.

Shell-Heap Archaelogy and Some Faunal Remains. By J. S. Erskine, Wolfville, Nova Scotia. (Read April 10, 1961). During 1960 a number of Indian campsites were excavated, chiefly on the South Shore. These showed a division of Nova Scotian Algonkian culture into two subcultures, the "Souriquoian" in the south west, the "Nigumakhian" from Lunenburg County east and northward. Oysters and quahogs were shown to have survived in Mahone Bay until about the eleventh century and quahogs at least until the thirteenth century in St. Margaret's Bay. The appearance of caribou in Nova Scotia can be recognized in the thirteenth century, and they seem to have replaced white-tailed deer by the fifteenth century. Periwinkles (littorina Littorea Linne) were found in two sites of the thirteenth century by St. Margaret's Bay, and the dating was supported by carbon-testing.

Analysis of Ballistograms by Means of a Circulation Model. By W. Josenhans, Dalhousie University. (Read March 13, 1961). A circulation model was developed which (a) gives a ballistrogram nearly identical to the human ballistogram, (b) has similar values as in man of infracardial and intraarterial pressures, pulse rate and stroke volume.

Parameters such as stroke volume, heart rate, blood pressure, flow ratio upper to lower body were varied one at a time and their influence was determined on the ballistogram. The size and shape of the ballistogram will be explained in so far as these experiments carry us.

Phenanthrene, An Anti-Initiating Agent. By T. Y. Huh and J. A. McCarter, Dalhousie University. (Read May 8, 1961). Phenanthrene applied at the same time as the carcinogenic hydrocarbon 9, 10-dimethyl-l, 2-benzanthracene to the skin of the CFW female mouse inhibited the tumorinitiating activity of the latter substance.

The Application of Classical Collision Theory to Problems of Enzyme Physiology. By J. G. Kaplan, Dalhousie University. (Read May 8, 1961). The catalase activity of intact, anaerobically grown, yeast cells is not cryptic, that is, lysis of the cell does not reveal additional activity. Despite this, the activation energy for the enzyme-substrate system is considerably higher for the intact anaerobic cell (919Kcal./mole) than for the cell lysed by treatment with butanol (46.

Kcal./mole). An attempt has been made to explain this phenomenon in terms of classic collision theory, applying the equation $k'' = A \exp(—H^*/RT)$ where the terms have their usual meanings and A is the frequency factor, defined by the following relation: $A = P Z$, where Z is the collision number and P the so-called steric factor. P may be considered a correction to take into account that the colliding molecules must have the proper orientation in order for the reaction to occur. Calculations of the steric factor (P) have been made, yielding a value of 2×10^2 for the intact cell enzyme and 1×10^{-2} for the lysed cell enzyme. This difference of four orders of magnitued has been interpreted to indicate that the enzyme in the intact cell is oriented in such a way as to make an activated collision with substrate much more probable than after the enzyme has been released from its intracellular configuration by lysis. Since log P is proportional to the entropy of activation, it follows that S has gone down following lysis (by approx. 20 e.u.). It is believed that classical collision theory provides a more helpful picture of the consequences of cell lysis than does the theory of absolute reaction rates.

The Strawberry Virus. By D. L. Craig. (Read Valley Chapter February 6, 1961). The Kentville Research Station's application of fundamental research to the problem of strawberry viruses was explained in detail.

In 1949 Nova Scotia strawberry stock has reached an advanced stage of degeneration. Improvement through selection and propagation of superior clones did not obtain the desired results. Virus was found to be the cause of plant degeneration. Most varieties, were found to be symptomless virus carriers and the wild strawberry *Fragaria vesca* was found to be virus sensitive and therefore a suitable indicator plant.

A scheme was devised by the Research Station and the Provincial Department of Agriculture for the propagation and distribution of virus free strawberry plants. This scheme is in effect at the present time. This scheme has been a major factor in the recent doubling of strawberry acreage in the province and in the substantial yield increases that have occurred.

Plants expressing a number of known viruses were demonstrated. The newly discovered soil viruses were discussed as was the possibility of obtaining tolerance to virus by the application of plant breeding techniques.

It was suggested that the program for the production of virus-free strawberry plants could and should be extended to other fruit crops such as the red raspberry.

The Utilization of Sphagnum Peat Bogs for Crop Production. By D. C. MacKay and E. W. Chipman. (Read Valley Chapter, March 6, 1961). Experiments initiated in 1952 have indicated that sphagnum peat bogs, when cleared and drained, provide a good physical media for growth of economic plants. In general peat soil is a poor source of plant nutrients and requirements for the major elements, nitrogen phosphorus and potassium are high. Calcium and magnesium are necessary as well, and are supplied by dolomitic limestone which is also required to correct the acidity. Of the trace element nutrients, boron has given response with some crops and recently molybdenum deficiency has been identified.

The extreme acidity and other conditions have presented problems not encountered in other organic soils or in inorganic soils. It is expected that a thorough experimental program will continue to provide answers to these questions as they arise, and that these areas will be valuable agricultural soils in the future.

ERRATA

Volume 25, Part 1. "The Orthoptera of Nova Scotia," by V. R. Vickery.

Page 2, para. 6, lines 5 and 6 — For 'Colchester' read 'Hants'.
Page 7, para. 5, line 4 — For '*Chorthophaga*' read '*Chortophaga*'.
Page 37, para. 4, line 4 — For 'Cholchester' read 'Hants'.
Page 38, line 11 — For '*Nemotettix*' read '*Nomotettix*'.
Page 33 line 2 — Insert 'Hist. Nat. between 'Mem' and 'Ins'.
Page 59 line 14 — For '*Acryptera*' read '*Arcyptera*'.
Page 61 line 3 — For '*Chorthphaga*' read '*Chortophaga*'.
Page 69 line 17 — For '*Chorthophaga*' read '*Chortophaga*'.
Page 70 line 18 — For '(Chorthopaga)' read (Chortophaga)'.
Page 70 line 19 — For '44' read '43'.

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1964
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PROCEEDINGS

OF THE

Nova Scotian Institute of Science

HALIFAX, NOVA SCOTIA

VOL. 25 1961-1962 PART 4

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Printed for the Institute by Rolph-Clark-Stone, Maritimes, Limited

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VOL. 25 - PART 4

THE NOVA SCOTIAN INSTITUTE OF SCIENCE

C. B. Fergusson

Provincial Archivist.

(Received for Publication, September, 1962)

EARLY ORGANIZATION

A well-known philosopher once defined science as organized knowledge, and a famous lord chancellor in England said that knowledge was power. In the spirit of these sentiments, and motivated by the impelling desire to make Nova Scotia great, the founders of the Nova Scotian Institute of Science inaugurated this society in 1862. Today this Institute, which is one of the oldest learned societies in Canada, celebrates its centenary.

Nevertheless, the founders of the Nova Scotian Institute of Science were not the first Nova Scotians to be imbued with an urge to make this province great by means of an association of this nature. There had been previous efforts, some barren, others relatively fruitful in their results, but none achieving a century of sustained and beneficent activity.

Attempts to investigate and exploit the coal fields of this region had ushered in a period that was favourable to the application of science to mining. This became particularly evident after the founding of Sydney, when a mineralogist named James Miller, who was a friend of Edmund Burke, was sent out to examine the coal mines and to report upon them. Miller received this appointment in 1793, four years after the founding of our first college—King's—in 1789.

At that time there was no provision at King's College for training in science, but the need for it was recognized. On November 26, 1792, Bishop Charles Inglis had expressed it in these words: "...The want of a professor of Mathematics and Natural Philosophy is sensibly felt..."[1] He reiterated it to Lord Grenville on June 28, 1793, as follows: "...Among the students are several very ingenious young men; but their improvement is much checked for want of Professors; especially a Professor of Mathematics and Natural Philosophy.."[2]

It was hoped that Miller would fill this need, and *The Weekly Chronicle* and *The Royal Gazette*, two Halifax newspapers, greeted this anticipation in the spring of 1794 with these words:

> ...It must afford pleasure to the friends of Literature in this rising Colony, to be informed, that the College or edifice for this Excellent Institution is now in such forwardness, that it will probably be finished so far, before winter, as to admit the Students. It is also a pleasing circumstance that JAMES MILLER, Esq., the Gentleman who is to be *Professor of Mathematics and Natural Philosophy* in the College at Windsor, is arrived. The superintendance of Royal Mines in these parts, is committed to this Gentleman, who is eminently skilled in Mineralogy as Chemistry [*sic*]. This business, we understand, will carry him to Cape Breton for some time; but it is expected that he will return in autumn. By that time a Philosophical Apparatus, which the Governors of the College have sent for to England, will probably arrive; and then he can enter on his department at the College with more benefit to the students.[3]

But this expectation was not realized. It took time to complete a charter for King's College, and pending its preparation there was no professorship for Miller. Consequently he devoted himself to the coal mines and the other mineral resources of the region until his death in 1799.

Within a few years of Miller's death, Titus Smith, a pioneer naturalist who was known as the Dutch Village Philosopher, made a survey of the unsettled areas of the province. His report, which was prepared for the Government, contains an account of the soil, the trees, and other resources.

Meantime certain significant developments had been initiated in education and a number of reading rooms and libraries were soon established. Although a system of free schools supported by compulsory assessment was not to be provided until 1864-1865, the Province encouraged education by means of a number of statutes. Common schools increased in number; the secondary schools established at Windsor and Halifax in the late 1780's continued in operation; and after the Grammar School Act was passed in 1811 a number of grammar schools were set up in other counties. Rev. Thomas McCulloch, who was to be an advocate of educational freedom and a pioneer in scientific instruction, not only organized a grammer school at Pictou, but became the founder and first principal of Pictou Academy and the first Principal of Dalhousie College. The Windsor Reading Society had its origin in 1792;[4] circulating libraries were in operation at Halifax as early as 1806; and a network of public libraries, whose use was restricted to subscribers, was established, one at Truro by 1812, another at Halifax in 1823-1824, and others at various places during the interval or in later years.[5]

Although there was still no provision for scientific training, Haligonians got an amusing glimpse of chemistry in the summer of 1825 when a man named Wyman delivered several introductory lectures at the Exchange Coffee House.[6] His subjects were atmospheric air and combustion, illustrated by experiments, including the exploding of balloons filled with a mixture of hydrogen and oxygen, and the making of laughing gas, which as *The Acadian Recorder* put it "produced most uncommon effects on the organs of risibility in some subjects. . ." These lectures, delivered leisurely, and illustrated with experiment, were attended by large audiences, who found them useful and interesting.

In the autumn of the same year another attempt was made to put King's College on a better financial footing. It now had a charter under whose terms no one who did not subscribe to the Thirty-Nine Articles could qualify for a degree. Arrangements were made not only to appoint a Professor of Mathematics and Natural Philosophy but also to purchase a philosophical apparatus.[7] Pierce Morton, who had been senior Wrangler at Cambridge, was the new Professor, but he did not stay long. One day the next spring he wrote a letter home and hastened to the wharf at Windsor in order to put it aboard the packet. The ship had already left and was a short distance down the river. Professor Morton got into a boat and went after her; he did not catch up with the packet until she reached Hantsport. Then he got on board the ship himself, and soon found himself at Saint John, from where he continued on to England.[8] Home-sickness, the whim of the moment or a desire to escape from King's College or the Windsor area brought about Professor Morton's departure and left the College without a Professor of Mathematics and Natural Philosophy.

The presence of another Englishman in Nova Scotia about the same time prompted a proposal for the formation of a Geological Society. This occurred at a time of renewed interest in the mineral resources of the Province, for Messrs. Rundell, Bridge and Rundell, London jewellers and goldsmiths, were about to obtain a sub-lease of the Duke of York's mineral rights in Nova Scotia, as well as a lease of certain mining rights in Cape Breton, the General Mining Association was soon to be formed, and a group of Nova Scotians were about to begin iron mining in Annapolis County. Joseph Backwell, a mineralogist, reached Halifax on August 18, 1825,[9] for the purpose of investigating the mineral resources of the Province. A few months later, the editor of the Halifax *Free Press* wrote: "We have for a long time felt a hope, that a Geological Society would be formed in Halifax; but the greatest difficulty which has hitherto existed, as respects such an Institution, was founded in the want of an individual possessing a practical knowledge of that science. This difficulty no longer exists; — there is a gentleman at present in this Province engaged in scientific pursuits, who is perfectly willing to lend his aid to the formation of such a Society. . ."[10]

Although Backwell was eager to see such a society formed, he announced that the large demands which his public duties made upon his time would not permit him either to become one of its active officers or to promise it a regular and steady assistance.[11] For the project, however, he had encouragement and advice, and would be willing to give any other necessary assistance which his limited time would allow. "Every person is aware from the confined enquiry that has already been made," he wrote, "that the mineral possessions of this and the neighbouring Colonies are of some value; but this information — requires to be extended and made accurate, before it can be turned to beneficial purpose. The true way to reach this is by the organization of a public Society supported either by general subscription, or in any other way that may be deemed proper . . ."

The subject was also taken up by other newspapers. *The Nova Scotian* regarded the project as "one of the first importance to the Provincial character and progress,"[12] while *The Weekly Chronicle* appeared to think that making geology a branch of education in a university would be a more feasible plan.[13] To the mind of the editor of *The Acadian Recorder*, however, the proposal was commendable but somewhat premature.[14] "The inhabitants of this country," he wrote, "should first strip the rude mantle of nature from the surface of the earth, before they enter into researches about the deluges of Deucalion and Noah."

After these comments appeared, Backwell again referred to the matter. He declared that "the only and true method in the present situation of the Province is to establish a Society in Halifax, under the sanction of influence, and regulated by a matured system. I give it as a matter for reflection; whether it would not be well to attach this Institution either to the Halifax Library, or to the P. Ag. Society?"[15] He wrote a booklet, "An Introduction to the Study of Mineralogy, Or Students Pocket Companion,"[16] of 58 pages, which was published in 1826 by Edmund Ward of Halifax, and he earmarked the profits from its sale for the Halifax Library, where it was intended to form a collection of the geological and mineralogical productions of the Province. Although a geological society was not then formed, doubtless Joseph Backwell's aid was useful in making possible the display in the Halifax Library in 1828, when similar collections could be seen in the Garrison Library and in the Library of the Army Hospital in Halifax.[17]

Interest in the proposal to organize a geological society revived in 1828, when Charles T. Jackson and Francis Alger, of Boston, who had recently been in Nova Scotia, published in *The American Journal of Science and Arts* "A Description of the Mineralogy and Geology of a part of Nova Scotia." Copious extracts from this account were printed in two of the Halifax newspapers, and local editors advocated action. *The Novascotian* regretted that so little had hitherto been done and by ourselves towards exploring and ascertaining the geology mineralogy of our country.

> At this period of our progress we ought really to be ashamed to be dependent on the inhabitants of other lands for a little scientific knowledge of our own — to neglect the treasures before our eyes, and be obliged to hear from strangers what it concerns us to know, and yet what we are too careless or too indolent to learn. . . At our highest institutions of learning, we believe, a fair knowledge of it may be obtained, but hitherto very few of our graduates have considered it an object worthy of after cultivation; and to the great mass of the reading, thinking, and intelligent, of our population, the science is a thing hidden-a book sealed. . . A Society might easily be formed here, and another at St. John, for the purpose of making full collections of Mineralogical specimens, and watching over this branch of Science; and, with a very trifling expense either of time or money, might, in a few years, by the emulation and interest they would create, and by the judicious application of honorary rewards, do much towards the acquisition of correct and valuable information; and thereby rescue the Province from the reproach of being far behind the rest of the world in an acquaintance with geological and mineral formations. . . It may be said, that we have no Lecturers, no Professors, no Books; but the latter may be procured, and as to the former, however desirable they might be, much could be done without them. . .[18]

The Free Press repeated the hope that some effort would now be made to form a geological society. This Province, it added, "abounds in minerals and other valuable substances, to which the attention of such an Institution might be profitably directed; and the individual amusement and instruction that could be afforded, would be ample and unfailing."[10]

By this time, however, one distinguished Nova Scotian was making his mark in science, as teacher, lecturer and founder of a museum. This was Rev. Thomas McCullouch, D.D., who in 1822 had been awarded the D.D. degree, by the University of Glasgow, partly "in consideration of the valuable donation of Insects lately presented by him to [that] University", and who by 1823 had been elected an Honorary Member of the Wernerian Natural History Society of the University of Edinburgh, an Honorary Member of the Literary and Philosophical Society of Newcastle, and an Honorary Member of the Antiquarian Society of Newcastle.[20] At Pictou Academy Dr. McCulloch introduced his students to Chemistry and Natural Philosophy, and used philosophical apparatus and museum specimens to illustrate his teaching. At Pictou in the spring of 1827 he delivered a course of popular lectures in Natural Philosophy, with experiments, which *The Acadian Recorder* referred to as "presumably the first of the kind delivered in Nova Scotia."[21] Three years later he delivered similar lectures to crowded audiences in Halifax.[22] By that time his natural history museum at Pictou had taken form, and Audubon, the American naturalist, was both surprised and delighted to find such a collection there, when he visited the place in 1833. A year later McCulloch's museum was taken to England and sold there. Subsequently, after he became Principal of Dalhousie College, McCulloch and his family built up another natural history collection in Halifax.

Three other Nova Scotians who demonstrated a keen interest in Natural History or Natural Science were Richard Garland, Andrew Downs, and Abraham Gesner. Garland, son of a Kingston-upon-Hull solicitor and attorney-at-law, was sub-librarian of the Halifax Library,[23] which had a geological and mineralogical collection. In 1833-1834 he advanced a proposal for the establishment of a museum of natural history.[24] Downs also had a fondness for natural history; near the head of the North West Arm in 1847 he was to establish the first zoological gardens in America north of Mexico. Dr. Gesner published his *Remarks on the Geology and Mineralogy of Nova Scotia in* 1836. Another Nova Scotian naturalist of distinction was J. W. (later Sir John William) Dawson, who was associated with Sir Charles Lyell in 1846 and 1852 in an investigation of the geology and mineralogy of the Maritime Provinces, and who published a book entitled *Acadian Geology* in 1855.

If difficulties in the way of the formation of a geological society had not yet been overcome, a significant milestone was reached in this Province with the creation of the Halifax

Mechanics' Institute late in 1831. At that time Halifax, still unincorporated, had fewer than fifteen thousand people, and the total population of the Province had not yet reached one hundred and seventy thousand. But aware not only of local needs and possibilities, but also of the aims and achievements of Mechanics' Institutes in the British Isles and of those recently formed at York in 1830 and at Quebec in 1831, Nova Scotian editors described the advantages to be derived from associations for mutal improvement and advocated similar institutions for this Province. Interested individuals took up the cause, with the result that the Halifax Mechanics' Library and the Halifax Mechanics' Institute were both organized in 1831.[25] The primary aims of the Mechanics' Institute included the accumulation of models and apparatus, the introduction of such mechanical improvements as had been discovered in other countries, the diffusion of knowledge of such as might be invented here, and the procuring of lectures on scientific and other subjects from members of the society or other competent persons. It began with a membership of 52, and for twenty-five years it contributed a great deal to the educational and cultural life of Halifax. It was an adult education movement, varied in content, providing vocational training and education in the arts and science, at a time when Dalhousie College was still in its stone age, having a stone building, but neither staff nor students. Lectures dealt with everything from climate to cart-making, from history to hydraulics and from mechanics to music, and the steam engine, metals and science, chemistry, geology and mineralogy were included. An average of 200 persons attended meetings in January 1832, and as many as 237 tickets were issued in the year 1846. Eventually it went into decline in the 1860's.

While the Halifax Mechanics' Institute was still thriving, the Halifax Literary and Scientific Society was established in 1839.[26] It was somewhat similar in character to the Mechanics' Institute, but its emphasis was more on literature than on science. It met in a room in the old Dalhousie College on the Grand Parade. It considered such matters as mental improvement,[27] and discussed such questions as: Should more than one College in Nova Scotia receive Provincial aid?[28] Should domestic manufacturers be aided by protective duties or should free trade be given unlimited scope?[29] It held annual festivals, with quoits, ball games, gymnastic exercises and other amusements, as well as refreshments.[30] At its regular meetings young men not only obtained practical experience in public speaking, but realized the advantage of storing their minds with useful information. It was rather exclusive in character, for its meetings were held behind closed doors, and it was small in numbers.[31] After a few years it seems to have dropped part of its original title, and it was thereafter listed in the almanacs as The Halifax Literary Society until 1846.

The Halifax Literary and Scientific Society ceased its activity, but the Halifax Mechanics' Institute continued its career. Eventually, however, interest in it began to wane, other lectures cut into its membership and its attendance, and the organization and training of the Volunteer Companies absorbed the time and the attention of many of the young men of the area.

Nevertheless, there were persons who would be interested in a society whose meetings would deal with important questions and give a hearing to original papers, and steps were now taken to found one. By circulars and by notices in the newspapers, a meeting was called for January 4, 1859 in Dalhousie College.[32] Andrew MacKinlay, President of the Halifax Mechanics's Institute, was chairman of this meeting, when it was decided that a society should be established in this Province, to meet in Halifax, or at times in other places, for the reading and discussion of original communications on such subjects in Literature, Science, Political Economy, Commerce, Statistics and the Arts, as might tend to draw forth talent and useful information; to encourage the study of history, natural history, products and capabilities of the Province; to foster a spirit of enquiry and enterprise, and generally promote the advancement of science, learning, and the useful arts. It is clear that in its emphasis on original contributions it differed in some degree from the Mechanics' Institute; and Andrew MacKinlay, President of the Mechanics' Institute, not only presided at the founding meeting of the new society, but was also chosen as its first President.

At this inaugural meeting 21 members were enrolled, and subsequently 56 others added their names to the membership. Besides President MacKinlay, the officers included Rev. Dr.

J. M. Cramp (Principal of Acadia College) and Dr. Charles Cogswell as Vice-Presidents; S. L. Shannon as Treasurer; and Hugo Reid and William Garvie as Secretaries. There was also a Council, at first of 16 and later of 21, including Hon. Stayley Brown; Henry How, Professor of Chemistry and Natural History at King's College; Rev. J. M. Hensley, Professor of Mathematics at King's College, and T. B. Akings (Record Commissioner of Nova Scotia.)

For about three years the Nova Scotia Literary and Scientific Society continued to meet. During its first session, papers were delivered at six meetings. These were the opening address of the President; "On the kind of Education best suited for Nova Scotia" by Dr. Charles Cogswell; "Notes on the Preservation of Timber Buildings from Fire" by Lieutenant Home, R. E.; "Decimal Currency", by Hon. W. A. Henry; "The Fossiliferous Rocks of Arisaig, Sydney County, Nova Scotia" by Rev. D. Honeyman; "Warming and Ventilation" by W. S. Symonds; "Description and Analysis of Three New Minerals, Associates in the Trap of the Bay of Fundy" by Professor Henry How; and "The Advantages of Local Museums in connection with Mineralogical Studies" by Henry Poole. The programme for the second session was made up of twelve papers, dealing with such subjects as "The Pre-Columbian Discovery of America", "On Some Points of Interest in the Geology of Nova Scotia", "Electric Currents", "The Botany of the Carboniferous Rocks of Nova Scotia", "The Saxons of Germany", and "Recent Discoveries of Roman Remains in Britain". During the session of 1861 - 1862 the proceedings of this society were interrupted by the occupation of Dalhousie College by the military authorities, but its meetings were resumed late in March 1862.[33] Robert Morrow was its President at that time, with Dr. Daniel McNeill Parker and William Lawson as Vice-Presidents, and Dr. Charles Tupper as one of the members of the Council. At a meeting in March 1862 Israel Longworth of Truro read papers on the early Indian and French occupation of Cobequid and on the erection of Nova Scotia into counties.[34] The regular session of 1861-1862 was brought to a close by a meeting on April 7, when a paper on the edible mollusca of our seas, written by John R. Willis of the National School, and another on the animal creation, written by J. M. Jones, were read.[35] At the end of his account of this meeting, the Halifax *Morning Chronicle* reporter stated: "We are glad to see so suitable a position occupied by the Scientific Society, and hope that the next session may be characterized by increased activity and usefulness." Despite this comment, that meeting was probably the last regular meeting of the Nova Scotia Literary and Scientific Society, although a special meeting of it was called for June 10, 1862,[36] when its proceedings may have been terminated for a variety of reasons.

The circumstances which killed the Nova Scotia Literary and Scientific Society called the Nova Scotian Institute of Science into existence. Those circumstances were in a setting which had been marked by significant developments within the preceding two decades. Halifax had been incorporated and it now had its own elected administration. At the provincial level responsible government had been introduced. In the economic sphere railway building was proceeding, control over the mines and minerals of Nova Scotia had been transferred to the Province, new coal mines were being opened, the tonnage of shipping was increasing, and gold had been discovered. The population of the Province had risen to more than 330,000 and Halifax now had over 25,000 people. The discovery of gold had attracted the attention of the world to Nova Scotia and its resources in 1860. Although the visit of the Prince of Wales had gratified all Nova Scotians in the same year, that gratification was followed by the annoyance caused by the misrepresentations of a few English correspondents, a feeling which was to be mollified by the success achieved by Nova Scotian displays at the International Exhibition at London in 1862. Actually, some of the men who were involved in making arrangements for the Nova Scotian displays for this Exhibition were to be the ones to take the lead in the formation of the Nova Scotian Institute of Science. For some time, moreover, there had been a feeling on the part of a number of the members of the Nova Scotia Literary and Scientific Society that the range of interests and the variety of topics of that institution were too wide to do ample justice to scientific matters or to appeal to their practical minds. These factors combined to end the career of one society and to create another.

After having received an invitation from the Imperial Commissioners for the International Exhibition, Nova Scotia took steps to ensure an efficient representation of our various resources. A Provincial Board of Commissioners was established in 1861, comprising members of the Legislature and private persons, of which Hon. Joseph Howe, the Provincial Secretary, was chairman, and Andrew MacKinlay was vice-chairman. Among the other members were John Matthew Jones and Robert Morrow; two of the Acting Ex-Officio Members were Rev. Alexander Forrester, Superintendent of Education and Principal of the Normal School, and Professor Henry How of King's College; Agent and Superintendent in England was Rev. David Honeyman, who a few years later became the first curator of the Provincial Museum. R. G. Haliburton, son of Judge T. C. Haliburton, was Secretary of the Nova Scotian Commissioners for the International Exhibition. Committees were appointed on minerals, manufacturers, natural history, agriculture, and fish; and Andrew MacKinlay, James Thompson, J. Matthew Jones, Rev. Dr. Forrester and Hon. Benjamin Wier were the chairmen of those committees. In order that the geology and the minerals of the Province should be fully represented, the services of Rev. David Honeyman were secured, as well as those of Dr. How, Professor of Chemistry of King's College, and R. G. Haliburton, Halifax barrister, who was the secretary of the Commission. At the International Exhibition in 1862 Nova Scotian exhibitors were awarded 19 medals and 11 honourable mentions, and at the Royal Horticultural Show of the same year they received 13 medals. This creditable showing at those exhibitions evoked favourable publicity which vindicated Nova Scotia and its resources and inspired Nova Scotians to action along a number of lines. One result was the determination that the natural history of Nova Scotia in all its branches should be carefully studied.

R. G. Haliburton took the initiative in action for the formation of a society for that purpose. By means of a printed circular he called a meeting for March 28, 1862, with a view to establishing such a society. Among those to whom he sent copies of his circular were Rev. Dr. Cramp, Principal of Acadia College, Major B. H. Norton, United States Consul at Pictou, Rev. Dr. James Robertson of Wilmot, and Rev. John Ambrose of St. Margaret's Bay, all of whom greeted the proposal with enthusiasm, although they were unable to attend this meeting. "It appears to me eminently desirable," Dr. Cramp wrote, "that the Natural History of our Province, in all its branches, should be carefully studied. The formation of a Society for that purpose will be hailed with great satisfaction. It will lead, I hope, to the establishment of a Provincial Museum. . ."[37] "The object you have in view, is, to my mind," Major Norton stated, "of vast importance to the future well-being of the Province; and if rightly carried out, will do more to develop the valuable resources to be found within her limits, than from any other cause. . ."[38] Rev. Dr. Robertson concurred in the proposal. "Now it appears to me," he added, "that you are the very man to move in this business; and that your influence both here and in England could be most beneficially exerted in this behalf. . ."[39] Rev. Mr. Ambrose declared that such a society "will, if properly organised and worked, result in a great benefit to this Province." "The degree of notice," he added, "which Messrs. Jones and Willis have already attracted to this country from scientific men in other lands, and the new born love for Natural History which they have engendered in other minds among us, producing zealous co-workers — otherwise idle in this respect — plainly show what might be done if a Provincial Museum were established and a well-selected society formed. . ."[40]

Other preliminary meetings were soon held, and the Nova Scotian Institute of Natural Science was established. To Haliburton's circular of May 13, Rev. Dr. Robertson and A. P. Ross were among those who replied. The former wrote: "I am very glad indeed to understand from your Circular of the 13th Currt that you have succeeded in giving a local habitation and a name to 'The Nova Scotian Institute of Natural Science.' It is just the very thing we want at the present time, and will I have no doubt produce under discreet management benefits to the Province."[41] The latter, a barrister and a man of business, as well as one of the founders of the Pictou Literary and Scientific Society, though unable to attend the meeting of which he had notice, stated: "The Nova Scotia Institute of Natural Science has long been a desideratum in this Province and I have no doubt its formation will be productive of many valuable results. . ."[42]

One of those whose opinions were sought by Haliburton was Dr. Abraham Gesner. On May 15 Haliburton handed him a paper dealing with the proposed society, and Gesner, who was then staying at the Atlantic Hotel in Halifax, a native though not at that time a resident of the Province, suggested that geography and statistics might be added to Haliburton's catalogue of sciences. . .[43]

The Nova Scotian Institute of Natural Science was organized in the spring of 1862 and officers for the ensuing year were elected at a meeting on May 20. It was formed for the purpose of encouraging the study of natural science in all its branches, especially with reference to the productions and resources of this Province. It was proposed to hold evening meetings, for the reading of original papers on geology, mineralogy, botany, zoology, meteorology and physical geography, and to publish a selection of those papers annually.

The first officers elected were:

President	The Earl of Mulgrave
Vice-Presidents	J. M. Jones, F.L.S.; T. Belt, Esq.
Members of Council	Rev. Dr. Forrester, Dr. How, Dr. Cramp, Rev. J. Ambrose, Dr. Gilpin, J. R. Willis, Esq.
Secretaries	R. G. Haliburton, Captain Lyttleton
Treasurer	Captain Lyttleton[44]

An adjourned meeting was held at Haliburton's office at 53 Barrington Street the next night, and a general meeting of the society was called for Saturday, June 28, at 8 p.m. in the basement room of the National School, for the election of new members and other business. In the notice which he prepared for the morning newspapers, Thomas Belt, one of the Vice-Presidents of the Nova Scotia Institute of Natural Science, and also superintendent of the Nova Scotia Gold Company's mines, used these words:

> That very excellent institution, the Literary and Scientific Society, which is deserving of more support than it has hitherto received, embraces a wider field, and is open to the reception of historical and literary papers, which is not the case with the Nova Scotia Institute—it being more exclusively intended for the subjects already specified, and having a special reference to the resources of the Province.[45]

This notice appeared in *The Morning Chronicle* of June 21, 1862.

According to the oldest extant membership roll, 24 men were elected to membership on December 26, 1862. These included 5 military officers, 2 engineers, 1 superintendent of mines, 1 or 2 professors, 2 physicians, 3 or 4 lawyers, 2 clergymen, 1 school teacher, 1 press agent and 1 merchant. Among these were several amateur natural scientists of note.

Subsequently, at a general meeting held in the Hall of the Medical Society, Halifax, on December 31, 1862, new officers were appointed and other business was transacted.[46] J. M. Jones was chairman of this meeting, and the others present were: T. Belt, S. Gray, Dr. Gilpin, W. Gossip, R. G. Haliburton, Captain Lyttleton, H. Poole, Captain Hardy, J. R. Willis, and P. C. Hill. A draft of the by-laws which had been prepared by the Council was read, and at the desire of the Council and officers their resignations were accepted and a new selection was made. The Lieutenant-Governor now became Patron rather than President, and the other office-holders and members of Council chosen at this time were:

President	P. C. Hill (who was then Mayor)
Vice-Presidents	J. M. Jones and R. G. Haliburton
Members of Council	Dr. Gilpin, Rev. J. Ambrose, Henry Poole, Captain Hardy, T. Belt
Secretaries	J. R. Willis and J. B. Young
Treasurer	Captain Lyttleton

At this meeting it was decided that the next monthly meeting would be held on January 19 and that afterwards regular meetings would be held on the first Monday of each month. The Secretaries were directed to make inquiries as to procuring the Mechanics Institute Room at Dalhousie College or some other suitable place for monthly meetings. The draft of the by-laws with some slight modifications was unanimously adopted.

By the end of 1862 the Nova Scotian Institute of Natural Science, as it was then called, was solidly established and ready to embark upon that fruitful career which has now reached its centenary. It began less than three years after the publication of Charles Darwin's famous book *The Origin of Species;* as it embarks upon its second century perhaps The Nova Scotian Institute of Science also deserves Herbert Spencer's phrase "the survival of the fittest."

INSTITUTE ACTIVITIES

Having completed its organization and having adopted its by-laws, the Nova Scotian Institute of Natural Science began its scientific inquiry at a meeting in Dalhousie College on January 19, 1863.[47] Two papers were read that evening — "The Common Herring of Nova Scotia" by Dr. J. B. Gilpin was the first, and "Nocturnal Life of Animals in the Forest" by Captain Campbell Hardy, Royal Artillery, was the second. Dr. Gilpin and Captain Hardy were the first in a notable line of amateur natural scientists who contributed greatly to the success of the Institute in its early years. Ten years later Dr. Gilpin was elected President of the Institute, and as time passed Captain Hardy not only rose to the rank of Major-General but was the sole surviving original member of the Institute prior to his death at Dover, England, in 1919.

One of the chief objects of the Institute was that monthly meetings should be held for the purpose of reading papers upon, and discussing matters relating to, Natural Science.[48] The proceedings of 1863 in this direction are a sample of what was done and what could be done in the first period of the society. The papers presented by Dr.Gilpin and Captain Hardy in January were followed by President Hill's address on the purposes and objects of the Institute and Thomas Belt's article "Some recent movements of the earth's surface", at the meeting in February. At the next meeting R. G. Haliburton read his paper on littoral changes and Henry Poole delivered one "On the characteristic Fossils of different Coal seams in Nova Scotia." In April Dr. Forrester read his paper on the ferns of Nova Scotia and J. Matthew Jones contributed one entitled "Contributions to the Ichthyology of Nova Scotia." In May Dr. Gilpin gave a paper on Scymnus Borealis or Arctic Shark; Dr. Abraham Gesner, physician turned scientist, who had discovered kerosene oil in 1852, delivered one on "Gold and its separation from other Minerals;" R. G. Haliburton read an article on "New Materials for the History of Man derived from a Comparison of Customs and Superstitions of Nations;" J. R. Willis read Professor Henry How's paper on Magnesia-Alum, or Pickeringite, containing a little nickel and cobalt, occurring in slate, in Hants County; and Vice-President Jones read Colonel R. J. Nelson's communication on granitic formation in the neighbourhood. At the November meeting Dr. Gilpin's third paper of the year had to do with some of the mammals of the Province, and J. M. Jones, the new President, exhibited a collection of the reptilia of Nova Scotia, preserved by alcohol in glass tubes, and described their character and habits. In December Captain Hardy, one of the Vice-Presidents, read a paper on the natural history of the capelin, and J. M. Jones read one on the natural history of the mollusca of the Bermudas. These papers were discussed as well as heard by the other members of the Institute.

The persons who produced papers for the programme of 1863 constitute a typical sample of the membership as a whole at that time. Dr. J. B. Gilpin, native of Rhode Island, had graduated from Trinity College, Providence, and studied medicine in England, before practicing his profession at Annapolis Royal and then at Halifax. He spent his spare time in a study of the animal life of the province, and became widely known as an amateur zoologist.[49] Captain Campbell Hardy, born at Norwich, England, and educated at the Royal Military Academy, Woolwich, had a distinguished military career, and served in Nova Scotia from 1852 to 1867. He was retired in 1880, with the honorary rank of Major-General. Six papers by him were published in the Transactions of the Institute, and in 1869 he published in London his *Forest Life in Acadie*, recounting one of the most delightful phases of his life. P. C. Hill was a native of Halifax, who was educated at King's College and entered the legal profession. He became a lawyer, was mayor of Halifax from 1861 to 1864, a member of the Legislative Assembly in 1870-1871 and from 1874 to 1878, and Premier of Nova Scotia from 1875 to 1878. He was a man of literary rather than scientific tastes, and it was undoubtedly true that he was chosen President of the Institute in 1862-63 because he was mayor of Halifax at the time. Thomas Belt was a native of England, who conducted geological investigations in the gold fields of Australia, before becoming superintendent of the Nova Scotia Gold Company in 1862. He was a geologist and naturalist. R. G. Haliburton, son of T. C. Haliburton, was born at Windsor, educated at King's College and trained in the law. He practised his profession at Halifax, was secretary of the Nova Scotia Commissioners for the International Exhibition of 1862, and took a leading part in the formation of the Nova Scotian Institute of Natural Science. For a time he was aide-de-camp to the Lieutenant-Governor. He was an amateur ethnologist. Henry Poole was a well-known mining engineer and geologist, who had charge of coal mining in Pictou County. Rev. Dr. Alexander Forrester was the first Principal of the Normal School at Truro, and he held the dual position of Principal of the Normal School and Superintendent of Education from 1855 to 1864. After relinquishing the Superintendency in 1864, he continued as Principal of the Normal School until his death in 1869. John Matthew Jones was born in Wales, educated at the Middle Temple, London, but possessed of private means did not practise law. He spent some time in Bermuda, where he conducted researches in natural history, and afterwards he came to Halifax, where at the time his relative, the Earl of Mulgrave, was Lieutenant-Governor. He was an amateur zoologist and an enthusiastic collector, who had a large private museum and whose favourite zoological studies related to fishes, reptiles and mollusca. Dr. Abraham Gesner, born at Cornwallis, was both geologist and physician. He made a geological survey of New Brunswick and Prince Edward Island, discovered kerosene oil, and wrote many scientific papers and reports. *Remarks on the Geology and Mineralogy of Nova Scotia*, one of his books, was published in 1836. Henry How, a native of London, England, studied Chemistry at the Royal College of Chemistry, and was assistant professor of Chemistry at the College for Civil Engineers at Putney, analytical chemist to the British Admiralty Steam Coal Enquiry, and assistant professor at Edinburgh University and at Glasgow University, before being appointed professor of Chemistry and Natural History at King's College, Windsor, in 1854. He was one of the Nova Scotia Commissioners for the International Exhibition of 1862, and he helped to make a collection of the minerals of the Province for that exhibition. His writings include *The Mineralogy of Nova Scotia*, which was published in 1869. Colonel R. J. Nelson had been Commanding Royal Engineer at Halifax.

There were enthusiastic amateurs as well as professional men among the natural scientists who provided papers in 1863, with the amateurs outnumbering the professionals. During that year two of the amateurs were military officers. The subjects discussed ranged from geology and mineralogy to ichthyology, lepidoptera and reptilia.

Another object of the Institute was the publication of lists of the various natural productions of the Province, with such observations as their respective authors might deem necessary, as well as of a selection of the papers read at the meetings. Volume I Part I of The Transactions of the Nova Scotian Institute of Natural Science was published at Halifax in 1863, as the first number of a continuing series.

According to the by-laws adopted in 1862, four field meetings were to be held each year. Although it proved to be impossible to have four excursions of this nature annually, the Institute did arrange to have a number of very pleasant field meetings.

The first was held on June 11, 1864 at French Village, St. Margaret's Bay, for the purpose of investigating Indian shell-heaps in that vicinity.[50] Another was held on September 10th of the same year at Acadia Iron Mines, Londonderry. The members left by the evening train for Truro on Friday, September 9th, stayed there overnight, set out from Truro for Londonderry at an early hour on Saturday morning, and returned to Truro at 6 p.m., before continuing on to Halifax.[51] A third field meeting was held that year, with interested members going to Cole Harbour on September 21st in order to examine Indian shell-heaps.

One field meeting took place in 1865. It was at Waverley Gold Mines. On July 1st 14 members and friends went to the site by way of Dartmouth, Mr. James Woodman's livery stable providing two wagons for the trip at 5s. per person. After visiting the mines, they went to Mrs. Marshall's on the Dartmouth Road and sat down to a substantial dinner at 5 p.m. Another field meeting was planned for the Stewiacke area that summer and the Chief Commissioner of Railways offered free transportation for it; but so few members signified their intention to be present that this excursion failed to materialize.[52]

Field meetings were also planned for 1866, but only one took place. This was a pilgrimage on June 26th to the grave of Titus Smith, "the Dutch Village Philosopher," where an account of his life and work was given followed by a visit to President Jones's museum at "Ashburn."

Four years later an attempt was made to have a field trip on June 28th to explore the Indian shell-mounds in the vicinity of St. Margaret's Bay, but this proved to be a failure. The next year, however, there was a field excursion to Montague Gold Mines. On June 21, 1871 about 20 members and friends met at the Steam Boat Wharf and proceeded in the 2 p.m. boat to Dartmouth, from where they drove to their destination about six miles distant. Dr. Honeyman described the strata, and Walter Lawson, the proprietor of a portion of the mines, provided a conducted tour and explained the processes of crushing, amalgamating and retorting, after which he entertained his guests with coffee and crackers. The members and their friends returned to Halifax delighted with this outing.

In later years three other field meetings were held. One was at Grand Lake on August 24, 1876. Two occurred in 1878 — the first of these at Point Pleasant on August 3rd, and the second at York Redoubt on August 24th. These ended the field meetings of the Institute. Although others were subsequently proposed, none was held. The first by-laws had prescribed four field meetings per year, but when the by-laws were revised in 1884 it was provided that field meetings or excursions should be held at such times and places and under such regulations as the Council might from time to time determine. At the annual meeting in 1935, Harry Piers, the oldest active member, lamented the elimination of field trips and spoke about the desirability of reviving them.

At intervals the aims and objects of the Institute have been discussed. According to the original by-laws, there were to be regular meetings for the purpose of reading papers upon and discussing matters relating to natural science. There were also to be field meetings, and provision was to be made for the publication of lists of the various natural productions of the Province, with such observations as their authors deemed necessary, as well as of a selection of the papers that were read at meetings. In his inaugural address of February 1863, President P. C. Hill used these words:

> . . .Communication with each other; every laborer in the field casting his contribution into a common receptacle whence all can freely draw, can alone give these results of individual effort their highest value, and convert that

> which formed the recreation of a single mind into the component portions of one mighty whole.
>
> It is, then, to aid in this important work and to afford a well constituted and organized channel for the contributions to the general stock of knowledge of those among ourselves who are interested in the fascinating fields of knowledge embraced in the term "Natural Science" that the "Nova Scotian Institute" has been established. . .

On that occasion, Mr. Hill also stated: "In conclusion, I may add that the Society embraces in the field of its observations not only the Province of Nova Scotia, but also Prince Edward Island, Newfoundland, Labrador, and the Bermuda's localities, to which the scientific observer has hitherto paid but slight attention."[53]

Dr. A. P. Reid, a Halifax physician, was one of those who advocated broadening the scope of the Institute. To enhance its efficiency he urged it not to confine itself to natural science but rather to embrace within its ambit other branches of science, such as electricity, magnetism, astronomy and so forth.[54] Commenting upon this proposal early in 1872, Professor George Lawson, of Dalhousie University, then the Vice-President of the Institute, declared that, although the Institute took special cognizance of natural science, other branches of science, such as meteorology, had a place in its proceedings, and that the Institute virtually conformed to the views expressed by Dr. Reid.

At the annual meeting of 1874, by motion of Dr. Reid and Augustus Allison, it was unanimously decided to request the Council to report on the desirability of having the Institute divided into sections.[55] Shortly afterwards the Council agreed to the division of the Institute into three sections — one for Natural History, one for Ethnology, and one for Technology.[56] Subsequently, when the by-laws were revised in 1884, while Robert Morrow was President, the Institute retained its old name, but its object was given as "the promotion of scientific research."[57]

Eventually the name was changed. This was done in 1890, during the Presidency of Professor James Gordon MacGregor. At a meeting of the Council on March 4th of that year it was decided that a special business meeting would be called for the 24th of the same month to deal with three propositions of which notice would be given. These were:

1. Resolved that the name of the Institute be the Nova Scotian Institute of Science.
2. Resolved that the name of the Institute be the Nova Scotian Scientific Institute.
3. Resolved that the Council apply for an act of incorporation.

In accordance with these decisions, the special meeting was held at the appointed time, when, on motion of Augustus Allison and Alexander McKay, it was unanimously resolved that the first of the two alternative names should be chosen and that thenceforth this society should be called The Nova Scotian Institute of Science.

In the same year the Nova Scotian Institute of Science was incorporated. This was done by Chapter 123 of the Statutes of Nova Scotia of 1890. Part of one section of this statute runs as follows: "The object of said body shall be the promotion of scientific research,. . ."

Another indication of the modification of the character of the Institute is seen in the proceedings of 1917-18. At the annual meeting in 1917 it was announced that at the next ordinary meeting the question would be taken up as to whether the Transactions should be more particularly confined to the publication of papers on subjects bearing more or less directly on Nova Scotia, except in such non-local departments as chemistry and physics, "as has been the practice hitherto;" or whether the publication of papers of non-local subjects generally should be permitted. This question was dealt with at the ordinary meeting in February 1918, when, with only one member dissenting, this resolution was adopted: "Resolved that the N.S. Institute of Science throw open its Proceedings and Transactions to papers in all departments of science provided they are contributed by persons working in Nova Scotia."

Soon there was such a dearth of papers on natural science that Dr. E. Gordon Young, the President, drew attention to it in December 1930. He tried to redress the balance in some measure by announcing that that type of paper would be welcomed, as well as those of the kind that had been heard during the last few years.[58].

Early in the following year the Council appointed a committee, comprising the President (Dr. Young), Dr. Henderson, Dr. Chipman, and Rev. Brother Cornelia, to consider ways and means of obtaining papers for the meetings and for publication, and this committee was empowered to consider allied topics as it saw fit.

This committee made its report to the Council on October 26, 1931. This report was as follows:

> After careful enquiry and due consideration the committee submit the following recommendations to the Council of the Institute.
>
> 1. That the aim of the society at the present time should be the encouragement of papers pertaining especially to provincial matters in science. The descriptive and systematic paper on the fauna and flora of the Maritimes should logically be published in the Proceedings. This likewise applies to the geology of the region.
> 2. That enquiry should be made from all possible sources as to individuals doing or interested in work of the nature of natural history. The office of the Superintendent of Education, the Church of England Institute are suggested as such places.
> 3. That if any programme of popular lectures for the year be adopted it might be possible to choose topics pertaining to natural history by way of discovering interested individuals.
> 4. That representatives of the society be appointed in the various centres of research work in the province to assist in obtaining papers suitable for publication in the Proceedings.

At this meeting of the Council, another committee, composed of the President (Dr. Young), Professor Burbidge, Dr. Johnstone and Dr. Ritchie, was appointed to deal with the question of having popular lectures. Three suggestions were referred to this committee:

1. That one or two science lectures be given during the

year to the public on other evenings than those of the Institute meetings;

2. That the reading of research papers at the Institute meetings be supplemented occasionally by talks or papers other than reports of research work;
3. That science lectures be arranged for high school students.

On November 9, 1931, this committee reported at an ordinary meeting as follows:

> Your committee desires to recommend that the Institute do *not* undertake to provide lectures for the general public or for high school students, but that the occasional presentation of papers or lectures on matters of general scientific interest, at the regular meetings of the Institute, be favourably considered and that two such papers or lectures be provided for this winter.

This report was accepted, and the committee was authorized to arrange a programme as recommended.

The object of the Institute, as it related to original research and to popular lectures, was also discussed at later meetings. It arose in November 1934 when it was alleged that the reason for the resignation of one member was the stressing of research problems to the exclusion of topics of wider interest.[59] At that time Dr. Henderson pointed out that the function of the society had always been to confine itself largely to the presentation of papers embodying the results of original research, and the President (Harry Piers) declared that there was a need for more papers on fauna or natural history. At a meeting in 1935 one paper, though of high quality, but not embodying the results of original research, raised a question of principle. So that the Institute should not without proper consideration make a major change in policy, it was resolved that the Council of the Institute should be requested to reconsider the criteria which it used for the acceptance of papers. On September 30, 1935 it set forth its decision as follows: "Resolved that the Council of the Nova Scotian Institute of Science reaffirm the policy of the Institute of accepting for presentation at ordinary meetings only papers containing the results of original research."[60]

Later other changes were made in the by-laws. According to the revision adopted on October 11, 1939, the object of the society was stated to be "the promotion of scientific research, the holding of scientific meetings and the publication of proceedings."

Changing circumstances have brought about an inevitable shift in emphasis and created a problem of communication. In the early days there were few specialists trained in laboratory techniques and scientific research, all of whose working time was devoted to scientific endeavour. As time passed, however, old institutions were expanded and new ones were created, as the scientific revolution proceeded, resulting in a considerable increase in the number of specialists. Outside the field of natural history or natural science, few interested amateurs could follow the papers presented by highly trained specialists in many branches of science.

Some of these changes are indicated by institutional development. Dalhousie College was reorganized in 1863, with George Lawson as Professor of Chemistry, Charles Macdonald as Professor of Mathematics, and Thomas McCulloch, Jr., as Professor of Natural Philosophy. Soon Dalhousie College provided training in Experimental Physics and Mathematical Physics, the teaching of science was strengthened and expanded, laboratories were improved or established, a faculty of engineering was organized, medical training was given, clinics were created, and eventually in 1955 a course leading to the Ph.D. Degree in biological sciences was inaugurated. Professors at Acadia, St. Francis Xavier, St. Mary's and other universities became members of the Institute. The School of Agriculture, of which the Nova Scotia Agricultural College is an outgrowth, was started in 1885. The Nova Scotia School of Horticulture was formally opened at Wolfville in 1894. Other institutions having an important impact on this development include The Nova Scotia Technical College, the Dominion Experimental Farm or Regional Research Station at Kentville, the Fisheries Experimental Station, the Nova Scotia Research Foundation, the Naval Research Establishment, the National Research Council, and the Institute of Oceanography.

If in the early days there were excursions or "field days", the Institute has also held other special meetings of various kinds. Two such meetings were conversaziones. One of those was held in the Horticultural Hall, Horticultural Gardens, on Thursday evening, July 6, 1865, with about 200 persons in attendance. On that occasion the Hall was tastefully decorated with flags and with objects of natural science, and J. M. Jones, the President, not only delivered an address on the advantages which the Institute might be expected to confer upon the country, if it were properly supported and encouraged, but gave an interesting description of the butterflies and moths found in Nova Scotia. Dr. J. B. Gilpin gave an account of the manner of taking, curing and smoking Digby herrings (so-called), with illustrations, and William Gossip read a paper on the geological phenomena near Halifax. There was then an interval, during which ices, lemonade, strawberries and cream, and cakes were served, and afterwards Professor Lawson of Dalhousie College made some observations on the subject of botany and the President concluded the programme with appropriate remarks. A similar meeting was held in the new Provincial Building (later known as the Dominion Building, and now the headquarters of the Royal Canadian Mounted Police) on Monday evening, January 20, 1873, at 7.30 p.m. There was first a promenade in the Museum, after which at 8 o'clock about 200 persons assembled in the Hall below, where a platform had been erected and seats had been arranged. At 8.15 Lieutenant-Governor Doyle, the Patron of the Institute, took the chair. The programme included a paper by Rev. Dr. Warren on atmospheric air, illustrated by experiments, observations by Dr. A. P. Reid on coal and its products, a paper by Dr. Honeyman on Pre-Adamite life, and an address by Dr. Lawson on the development of cellular time. Then those in attendance proceeded to the Museum, which was brilliantly lighted, and examined the collections there, before going to an apartment for refreshments which had been provided by Rev. Dr. Warren, Mrs. Warren and Miss Clarke.

The question as to whether the Institute should provide popular lectures has been raised time after time, and it has been answered in different ways on different occasions. A series of such lectures was given in each of the years, 1922, 1923, 1924 and 1925, and one was also given in 1932. Dr. J. H. L. Johnstone, then Assistant Professor of Physics at Dalhousie University, gave one on "The Smallest Things in Nature (the Atom, Electron and Proton)," on February 27, 1922, and Professor F. Ronald Hayes delivered one on "The

Life of the Salmon", on January 11, 1932. Between those meetings there were other popular lectures on "Modern Aspects of Heredity", "Colour Photography", "The Mechanism of the Wireless Telephone", "The Quebec Bridge", "Races that Dwell above the Clouds" (i.e., those which live at least 12,000 feet above sea-level), "Weather in the Belt of Cyclonic Storms", "In-breeding and Out-breeding", "What Seeing Means", "The Lure of Nature Hiking", "The Age of the Earth", "Musical Sounds, their Nature and Quality", "Sightseeing at Banff and Lake Louise", "The Biology of the Pearly Mussel and its Ultimate Use in the Button Trade", "Elementary Discussion of Waves and Radiant Energy", "The Production, Transmission and Detection of Wireless Waves", "Short Wave Transmission and Reception", and "Transatlantic Reception and Disposal of News Traffic". Although these popular lectures generally attracted an attendance considerably larger than at ordinary meetings, there was considerable doubt as to their value, and ultimately in November 1931 the Institute reconsidered the matter. At that time the decision made was that popular lectures as such not be undertaken, but that the occasional presentation of papers or lectures on matters of general scientific interest at regular meetings be favourably considered. The general opinion of the Institute on Professor Hayes's address of January 11, 1932 was that the presentation of lectures such as that "would be advantageous in the future."

Subsequently, since September 1941, the Institute has held a number of extraordinary meetings at most of which visiting distinguished scientists have delivered addresses. Two of these formed part of the centennial celebration of 1962, with Dr. H. B. Newcombe, of Atomic Energy of Canada Ltd., speaking on radiation, man and his genes, at one, and Sir Bernard Lovell, Professor of Radio Astronomy, University of Manchester, and Director of Jodrell Bank Experimental Station, speaking on the exploration of outer space, at the other.

There have also been other commemorative meetings. One was held on January 20, 1913 for the purpose of marking the completion of the first half-century of the Institute. At that meeting Harry Piers read a paper entitled "A Brief Historical Account of the Nova Scotian Institute of Science, and the events leading up to its establishment; with Biographical Notes on some of those who have been prominent in its affairs."

Eleven members were present on that occasion. Nearly twenty-five years later, when the 75th anniversary was celebrated, with a public meeting in the School for the Blind, Major-General A. G. L. McNaughton, President of the National Research Council of Canada, gave an address on "The Organization of Research in Canada", to an audience of about 250 persons.

In the course of its first hundred years the Nova Scotian Institute of Science has held two free public scientific exhibitions. The first one was held in the Medical Sciences Building, College Street, Halifax, on Friday and Saturday, November 26 and 27, 1926. Assistance was afforded to the Institute by the various departments of Dalhousie University and the University of King's College, the Maritime College of Pharmacy, the Nova Scotia Technical College, the Atlantic Fisheries Experimental Station, and CHNS Radio Broadcasting Station, as well as by a number of students who aided in installing exhibits and explaining them to visitors. The exhibits and demonstrations related to physics, electricity, chemistry, biochemistry, geology, botany, bacteriology, zoology, fisheries, physiology, pathology, histology, embryology, pharmacy and dentistry, and took up nine of the large rooms in the building. A brief printed guide or folder was prepared and sold at ten cents per copy. The exhibition proved to be very popular and most successful. The estimated attendance on Friday evening was 1500; on Saturday afternoon 500; and on Saturday evening 2500; making an estimated total of about 4,500. As the Recording Secretary put it; "It was probably the first really notable exhibition of its kind ever held in the province."

The second scientific exhibition took place on Friday and Saturday, November 23 and 24, 1928, in the Science Building, Studley Grounds, and the Medical Sciences Building, College Street. The Governors of Dalhousie University, the managers of the Telephone Company, the Nova Scotia Tramways and Power Company and Moirs Limited, the managing director of Halifax Herald Ltd., the general manager of the Chronicle Company Ltd., the manager of Imperial Oil Ltd., and the representatives of Liquid Air Ltd. and Eastern Hosiery Mills, of Truro, all assisted in this undertaking. Programmes were sold, and a total of about 6,000 persons attended. Such was the over-crowding, particularly in the Medical Sciences Building, that the committee in charge suggested that if a similar exhibition were held in the future an admission fee should be charged in order to reduce the attendance to a comfortable limit. Finanacially, there was a small deficit for this exhibition. When it was discussed at a subsequent meeting, the prevailing opinion seemed to be that the labour involved in such an exhibition was so great that it seemed inadvisable to undertake another for some time.

Another project that the Institute promoted was the preparation of a catalogue of the scientific periodicals in the Maritime Provinces. This was initiated in 1934 and, with the assistance of a grant from the National Research Council, was carried to completion in 1936.

The publication of proceedings has always been one of the objects of the Institute, although this object has been expressed in slightly different ways at different times. It has been achieved, with financial assistance from the Provincial Government. The first selection of papers to be printed appeared in 1863, as "The Transactions of the Nova Scotian Institute of Natural Science, Vol. 1 — Part I." The next selection appeared in the following year, as Vol. II, Part I, with the same general title. But a new title "Proceedings and Transactions of the Nova Scotian Institute of Natural Science" was used on the selection of papers published as Vol. II, Part III, 1864-5, and this continued to be used until 1889. Then, with the alteration of the name of the organization from the Nova Scotian Institute of Natural Science to the Nova Scotian Institute of Science, the next selection of papers to be printed was given the title "Proceedings of the Nova Scotian Institute of Science", and this new title continued to be used until one portion of Vol. XVII, for 1928-29, was labelled "Transactions of the Nova Scotian Institute of Science." On November 24, 1930, the Council considered the title of the publication, and on January 26, 1931 it decided that it should be changed to "Proceedings of the Nova Scotian Institute of Science." This has been the name of the publication ever since that time.

To the establishment and development of the Provincial Museum, the Nova Scotian Institute of Science has contributed a great deal. In fact, as Dr. A. H. MacKay aptly stated, the Provincial Museum is "the ward of the government, but the child of the Institute."[61]

Although the Provincial Museum may be said to have originated in the efforts made by the Province in connection with the International Exhibitons of 1862, 1865 and 1867, there had been advocates of the establishment of such an institution in earlier years. As we have already seen, Rev. Thomas McCulloch, Richard Garland and others had attempted to do something on their own, and the Halifax Mechanics' Institute, founded in 1831, formed its own museum. Early in 1848 a suggestion appearing in *The Times* elicited the following facetious response from *The Nova Scotian*:

> A writer in the *Times* suggests the propriety of establishing a Provincial Museum. We approve of the object. Two or three active men, and a short Act of Incorporation, are only wanted to make a beginning. Some of our Correspondents have already offered to contribute:
>
> A String of Beads from Digby Neck.
> A bushel of roots that Gesner thought were potatoes.
> A dose of Morrison's Pills that had gone through the Gut of Canso.
> The Square Root of the Grand Rounds.
> A Fin of a Fish Market Shark.
> The Pole of the Barber, one sees between Halifax and Dartmouth.
> Some bristles from the Bore of the Shubenacadie.
> The Key to the Night Watch.
> The first half mile of the West India "League."
> A strand from the "Cunard Line.'
> A volume of smoke from "the Battle of Life."[62]

Subsequently, as the Province in 1861 made plans to see that its resources would be adequately represented at the International Exhibition in the following year, the project was revived and given renewed impetus. Several of the founders and early members of the Nova Scotian Institute of Science advocated action, and early in 1861 a petition to the Legislature from Cape Breton County proposed the establishment of Geological Museums in the several counties with a central institution of the same nature in Halifax.[63] Early in the next year there was a proposal by the Governors of Dalhousie College to establish a museum in connection with that institution.[64] On March 9, 1863, a petition from Rev. David Honeyman, who had been a Provincial Commissioner at the Exhibition in London in 1862, for the adoption of measures to found a Provincial Industrial and Educational Museum, was tabled in the House of Assembly.[65] Two years after that — on March 13, 1865 — another communication from Dr. Honeyman and John R. Willis in regard to the establishment of a Provincial Museum was read in the House and referred to the committee on mines and minerals. This committee considered the matter and made its report to the House.

Dated April 4, 1865, this report is as follows:

> The committee have examined the memorial of Dr. Honeyman and John R. Willis, advocating the establishment of a Provincial Museum, and have heard the latter gentleman in person; and while they entertain favorable views of the proposal, and fully appreciate the importance of the work, and the benefits to flow therefrom, yet the committee cannot recommend any active steps to be taken in the matter until the new provincial building is completed, and suitable apartments therein can be had as a depository for the proposed collection, free of charge. It appears, however, that there is at present a valuable collection of articles in the museum of the late Mechanics' Institute, and other places, which would be contributed to a Provincial Museum, and are being lost for want of proper care. The committee recommend the Government to take such steps as they may deem necessary to collect and preserve the same, provided the expense does not exceed three hundred dollars.[66]

Early in 1866 Dr. Honeyman proposed to Andrew MacKinlay, trustee of the Mechanics' Institute, that the museum of that defunct institution be made the nucleus of the Provincial Museum. MacKinlay and James Forman, the other trustee, agreed to this proposal,[67] and Dr. Honeyman then applied to the Provincial Government for accommodation for a museum in the new Provincial Building, then under construction. On May 9, 1866, the Lieutenant-Governor-in-Council directed the commissioners of that building to provide a room for a Provincial Museum.[68] Dr. Honeyman, who had had charge of the Nova Scotian exhibits at the International Exhibitions of 1862 and 1865, also looked after the provincial displays at the Paris Exhibition of 1867, and the Nova Scotia Commissioners purchased the natural history collections from the contributors, with a view to their being deposited in the Provincial Museum after their return from Paris. Finally, the Provincial Museum was founded in October 1868, when Dr. Honeyman was authorized to take possession of the room in the new building, and the Mechanics' Institute Museum and the specimens which had been exhibited in Paris were transferred to it. Dr. Honeyman became the first curator of the Provincial Museum, for a time without any remuneration.

Before long the two main objects contemplated had been fairly well realized. These were the formation of a permanent exhibition of the industrial resources of the Province with a view to their manifestation and development and the provision of means for illustrating the various branches of physical science and for furnishing the indispensable requisite for an effective scientific education.[69] In 1870 Dr. Honeyman started a Geological Class in the Provincial Museum, a development which he described in a letter of May 25, 1871 to the Hon. William Garvie, Chief Commissioner of Mines and Works, as follows:

> . . . Having an extensive and useful Geological Collection arranged in the Museum in every respect fitted for the illustration of the Sciences of Geology & Mineralogy especially in their application to Nova Scotia I proposed to open a Geological Class, and received the sanction of Hon. Robert Robertson to establish it. This was intended as a Pioneer to the establishment of a School of Mines. This class has passed its first Session, with perfect success. I have had 9 regular students and I anticipate a larger attendance next session. . .[70]

Members of the Nova Scotian Institute of Science had taken a prominent part in the creation of the Provincial Museum, and the association of these two institutions has continued. On February 6, 1872, Dr. Honeyman commented upon their relationship in his letter to the Superintendent of Education:

> . . .The Nova Scotian Institute of Natural Science is now associated with the Museum. The association is mutually beneficial and there is reason to expect that the interests of Science in Nova Scotia will thereby be materially advanced. . .

Over the years the Institute has accumulated a library of considerable proportions. It has been accommodated in a variety of quarters; now numbering nearly 100,000 volumes, part of it is in the library of the Nova Scotia Research Foundation and part in the Nova Scotia Technical College Building.

During the first hundred years of the Nova Scotian Institute of Science there have been things quaint as well as things common. One memorable development was announced at a meeting on May 13, 1879 by the President. This was that he had received a communication from the Royal Microscopical Society of London offering to confer the honorary title of Fellow of that Society, F.R.M.S., on the President of the Institute for the time being, and that the Council had decided to accept the honour. A remarkable incident in the course of the Institute is the fact that among the many papers indicative of the specialized interests of highly trained members there was one prepared and delivered in January 1935 by an eleven-year-old girl. As the Recording Secretary noted at the time, "this paper probably constituted a record in the activities of the Institute." A number of years later a man in another part of the Province tried to get the Institute to sponsor what he described as a cure for ringworm. He claimed to have discovered a "cure", certainly not unknown earlier, that the oily residue left after burning brown paper on iron or steel would serve as a remedy for that skin-disease.

In 1958 prizes were offered by the Institute to science students below the Master's degree at any of the universities or colleges in Nova Scotia for the best essay in each of the following fields of science:

(a) Physical Sciences and Engineering;

(b) Biological Sciences

The first award in this competition was made in 1959.

The membership of the Institute is now much greater than it was in the early days. Twenty-four men were elected to membership on December 26, 1862; now, however, there are 253 members. The admission fee for ordinary membership used to be 20 shillings and then $4.00, with an annual subscription of 10 shillings or $2.00. That admission fee remained constant until 1942 when it was raised to the modest sum of

$3.00. Associate membership was authorized on October 26, 1863, with an admission fee of 10 shillings and a yearly subscription of 5 shillings. Provision was made for life memberships in 1864 and 1866, in the first instance on payment of £5, and in the second case on the payment of $45 for ordinary members of less than ten years standing or $22.50 for those of ten or more years of good standing. Eventually student memberships were authorized in 1930 at a fee of $1.00 each, and in January 1935 this fee was reduced to 50 cents. Ladies, of course, have long been members of the Institute. Miss Bertha Elliot, Superintendent of Nurses, Victoria General Hospital, was admitted to membership in 1895, for example, and Miss Margaret R. Butler was elected to the Council of the Institute in 1934, the first lady to be so chosen.

There are also honorary members. In 1947 it was decided that honorary membership might be conferred on persons rendering sufficient service to the Institute, members holding responsible positions in science work related to Nova Scotian problems and now retired, or non-members who have made significant contributions to such problems. The first persons so honoured were Dr. L. C. Harlow, Dr. H. E. Bigelow, Dr. H. L. Bronson, Dr. John Cameron, Mr. P. R. Colpitt, Dr. A. G. Huntsman, Dr. S. G. Ritchie, and Dr. F. H. Sexton. Others later similarly honoured included Mr. Robie Tufts, Dr. E. Hess, Dr. R. J. Bean, Dr. J. H. L. Johnstone, Dr. Hugh Bell, Dr. A. Kelsall, Mr. F. Herman, Dr. P. M. Bayne, Dr. H. M. Creighton and Mr. J. A. D. McCurdy.

In addition, provision was made in 1951 for granting life membership to recording secretaries, corresponding secretaries, treasurers and editors with five or more years of service. A life membership was subsequently conferred on Dr. J. G. Aldous in recognition of his valuable services.

A branch of the Institute was organized at Wolfville in 1901, and it continued in active operation until 1904. Then that Kings County branch went out of existence. In 1952, however, a Valley branch or chapter was established at Wolfville, and it is functioning very successfully.

There have been attempts of various kinds to maintain or raise the attendance at meetings. Popular lectures have occasionally attracted larger audiences; special meetings have been held; and for part of 1940 and 1941 refreshments were provided at meetings. These inducements have had a temporary effect, though perhaps no great lasting value in increasing the membership. In the early days the institute owed much to a small number of devoted members. Later such men as Professor James Gordon MacGregor, Dr. A. H. MacKay and Mr. Harry Piers nursed it through trying times. Since 1947 the membership has risen from a total of 172 to 289 in 1953, and it now stands at 253 in the centennial year.

The Nova Scotian Institute of Science has had a variety of meeting places. Preliminary meetings in 1862 were held in R. G. Haliburton's office at 53 Barrington Street, the basement room of the National School on Argyle Street, and the Hall of the Medical Society. From Janucary to March 1863 it met in the old Dalhousie College Building. From April 1863 to May 1871, inclusive, its meeting place was Province House. In October 1871 it began to meet at the Provincial Museum, in the new Provincial Building (later the Dominion Building, and now the headquarters of the Royal Canadian Mounted Police), where it continued to meet until October 1878. Then it met in Dalhousie College until May 1881. For October and November 1881 it used the Provincial Museum again; it met in the Stairs Building in December of that year; and then it returned to the Provincial Museum till April 1887. It began to meet in the Provincial Engineer's Office in October 1887 and continued to do so until May 1888. It had its annual meeting in Province House in October 1888. Then it returned to the Provincial Engineer's Office for the meeting in November 1888, after which it began to meet in the Victoria Art School Rooms, where, with the exception of a meeting at Dalhousie College in February 1889, it continued to meet until April 1890 inclusive. From then until December 1909 it met in such places as Province House, the Provincial Museum, the Legislative Committee Room, the Church of England Institute, the Legislative Council Chamber, the City Council Chamber, the Provincial Science Library, the Assembly Chamber, the Room of the Mining Society of Nova Scotia, the Assembly Committee Room, and the Geological Lecture Room, Dalhousie College. On December 13, 1909, it began to meet in the Technical College, and continued to do so until November 1916. Since December 1916 it has met chiefly in buildings of Dalhousie University — The Physiological Lecture Room (Room 39) of the Forrest Building, the Munro Room in the same building, the Physics Lecture Room in the Science Building, Studley, the Physiological Lecture Room in the Medical Sciences Building, College Street, and the Dental Lecture Room, Carleton Street. The Medical Sciences Building is now and has been for some years the main meeting place. Occasionally, however, there have been meetings in the Biological Building, Acadia University; Elliot Hall, Acadia University; the Naval Research Establishment, Dartmouth; the Physics Lecture Room, Dalhousie University; the Nova Scotia Technical College or the Arts and Administration Building, Dalhousie University.

To commemorate its centennial the Nova Scotian Institute of Science not only sponsored two well-attended special lectures by distinguished visiting scientists but had a centenary dinner at the Lord Nelson Hotel, Halifax, on April 6, 1962. Dr. W. J. Archibald, the President of the Institute, was the chairman at this dinner, which was attended by about 110 persons, including Major-General the Honourable E. C. Plow, Lieutenant-Governor of Nova Scotia, and Mrs. Plow, Hon. R. L. Stanfield, Premier of Nova Scotia, and Mrs. Stanfield, and at which Dr. C. Bruce Fergusson, Provincial Archivist, delivered an address on the history of the organization.

LIST OF PRESIDENTS 1862 - 1962

1.	The Earl of Mulgrave	1862
2.	Philip Cartaret Hill	1862-63
3.	John Matthew Jones	1863-73
4.	Dr. John Bernard Gilpin	1873-78
5.	William Gossip	1878-80
6.	Dr. John Somers	1880-83
7.	Robert Morrow	1883-85
8.	Dr. John Somers	1885-88
9.	Professor James Gordon MacGregor	1888-91
10.	Martin Murphy, D.Sc.	1891-93
11.	Professor George Lawson	1893-95
12.	Edwin Gilpin, Jr., D.Sc.	1895-97
13.	Alexander McKay, M.A.	1897-99
14.	Alexander Howard MacKay, B.Sc., LL.D.	1899-1902
15.	Henry S. Poole	1902-05
16.	Francis William Whitney Doane	1905-07
17.	Professor Ebenezer MacKay	1907-10

18.	Watson Lenley Bishop	1910-12
19.	Donald MacEachern Fergusson	1912-15
20.	Professor David Fraser Harris	1915-18
21.	Professor H. L. Bronson	1918-20
22.	Professor John Cameron	1920-22
23.	Professor C. B. Nickerson	1922-24
24.	Dr. S. G. Ritchie	1924-26
25.	Professor J. H. L. Johnstone	1926-28
26.	Professor Douglas MacIntosh	1928-30
27.	Professor E. Gordon Young	1930-32
28.	Dr. Alexander Henry Leim	1932-34
29.	Harry Piers	1934-36
30.	Professor G. H. Henderson	1936-38
31.	Dr. H. S. King	1938-40
32.	Professor R. J. Bean	1940-42
33.	Dr. Ernest Hess	1942-44
34.	Professor F. Ronald Hayes	1944-46
35.	Professor C. C. Coffin	1946-48
36.	Dr. C. B. Weld	1948-50
37.	Dr. A. E. Cameron	1950-52
38.	Professor W. J. Chute	1952-54
39.	Dr. H. D. Smith	1954-56
40.	Dr. J. G. Aldous	1956-58
41.	Dr. J. R. Dingle	1958-60
42.	Professor W. J. Archibald	1960-62

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11. Novascotian, January 11, 1826, pp. 12-13.
12. Ibid.
13. Novascotian, January 18, 1826, page 21.
14. Acadian Recorder, January 7, 1826.
15. Novascotian, January 18, 1826, page 21.
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SOCIETIES EXCHANGING WITH THE NOVA SCOTIAN INSTITUTE OF SCIENCE, 1962

The following societies and institutions exchange their publications for the Proceedings of the Nova Scotian Institute of Science. The publications are available from the Librarian.

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R. Academia de Ciencias Y Artes de Barcelona
Academia Nacional de Ciencias "Antonio Alzate", Mexico
Academia Nacional de Ciencias, Cordoba, Argentine Republic
Academia Sinica, Peking
Académie des Sciences, Inscriptions et Belles-Lettres de Toulouse
Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique
Academy of Natural Sciences, Philadelphia
Accademia Delle Scienze Dell'Institute de Bologna
Accademia Delle Scienze di Torino
R. Accademia di Scienze, Lettere, e Belle Arti di Palermo
R. Accademia Nazionale die Lincei Rome
Accademia Nazionale dei XL, Rome
Aix-Marseille, Université
Akademia Athenon, Athens, Hellenikon Hydrobiologikon Institouton
Akademie der Wissenschaften, Gottigen
Akademie der Wissenschaften, Munich
Akademiia Nauk, SSSR, Matematicheskikh Institut Imeni V. A. Stekiova
Algiers, Université
American Academy of Arts and Sciences, Boston
American Geographical Society of New York
American Philosophical Society, Philadelphia
Archiv der Freunde der Naturgeschichte in Mecklenburg, Rostock
Archives des Sciences, Geneva
Archives Néerlandaises de Zoologie
Académie Royal Suédoise des Sciences, Sweden
Association Canadienne-Française pour L'Avancement des Sciences
Australasian Institute of Mining & Metallurgy
Australian Museum, Sydney
Australian National Research Council
Bayerische Botanische Gesellschaft zur Erforschung der Heimischen Flora, Munich
Beitraege zur Naturkunklichen Forschung in Sudwest Deutschland
Belfast Natural History and Philosophical Society
Bergen, Norway. Universitet
Berlin, Humboldt Universitat, Zoologischen Museum
Besancon, Université
Biological Society of Washington
Birmingham Natural History and Philosophical Society
Bloemfontein, Nasionale Museum
Botanical Society of Edinburgh
British Coal Utilisation Research Association
British Columbia, Provincial Museum
British Guiana Museum and Zoo

British Museum (Natural History), London
Brooklyn Botanic Garden
Brooklyn Institute of Arts and Sciences, Botanic Garden
Budapest, Orszagos Museum
Buenos Aires, Instituto Nacional de Investigacion de las Ciencias Naturales
Buenos Aires, Universidad Nacional Facultad de Ciencias Exactas, Fisicas Y Naturales
Bulgarska Akademiia Na Naukitie, Sofia
California, University
California Academy of Sciences
California Dept. of Fish and Game, Marine Fisheries Branch
Canada, Fisheries Research Board
Canada, National Museum
Canada, National Research Council
Canadian Phytopathological Society
Cardiff Naturalists' Society
Carlsberg Laboratoriet, Copenhagen
Ceskoslovenska Akademie Ved (Matematicky ustav)
Ceskoslovenska Spolecnost Entomologicka, Prague
Chicago, Natural History Museum
Ciccolo Matematico, Palermo
Coimbra, Universidade, Instituto Botanico
Colombo Museum
Commonwealth Scientific and Industrial Research Organization
Dansk Botanisk Forening
Dansk Naturhistorisk Forening, Copenhagen
K. Danske Videnskabernes Selskab, Copenhagen
Denison University, Granville, Ohio
K. Deutsche Akademie der Naturforscher zu Halle
Deutsche Akademie der Wissenschaften zu Berlin
Dresden, Staatliches Museum fur Mineralogie und Geologie
Drumfrieshire and Galloway Natural History & Antiquarian Society
Durham, University, Philosophical Society
Ecuador, Universidad Central, Quito. Instituto de Ciencias Naturales
Edinburgh Mathematical Society
Elisha Mitchell Scientific Society
Entomological Society of British Columbia
Entomological Society of Canada
Entomological Society of Ontario
Entomologiska Foreningen, Stockholm
Finska Forstsamfundet, Helsingfors
Finska Vetenskaps-Societeten, Helsingfors
France, Centre National de la Recherche Scientifiques
Franklin Institute, Philadelphia
K. Fysiografiska Saliskapet, Lund, Sweden
Geographische Gesellschaft in Hamburg
Geological, Mining and Metallurgical Society of India, Calcutta
Geological Society of London
Geologische Bundesanstalt, Vienna
Geologische Stichting, Netherlands
Georgia Academy of Science
Gesellschaft zur Bedforderung der Gesammten Naturwissenschaften, Marburg

Ghent, Universiteit
Harvard University, Astronomical Observatory Museum of Comparative Zoology
Illinois, Natural History Survey
Illinois, University
Indian Museum, Calcutta
Indiana, University. Goethe Link Observatory
Indiana Academy of Science
Institut Danois des Échanges de Publication Scientifiques et Littéraires
Institut des Hautes Études Scientifiques, Paris
L'Institut des pêches maritimes, Paris
Institut Grand-Ducal de Luxembourg, Section des Sciences Naturelles, Physiques et Mathematiques, Archives
L'Institut Oceanographique de Monaco
Institute of Agrochemical Research, Budapest
Institute of Science & Technology, Manila, Philippines
International Commission for the Northwest Atlantic Fisheries, Halifax
International Council for the Exploration of the Sea, Copenhagen
International Oceanographic Foundation, Marine Laboratory, University of Miami
Iowa-State College
Istituto Lombardo di Scienze E Lettere, Milan
Istituto Veneto di Scienze, Lettere ed Arti, Venice
Japan Academy, Tokyo
Jassy, Roumania, Institutl politechnic
Kagoshima, University. Faculty of Agriculture
Kansas, University, Lawrence. Museum of Natural History
Kansas Academy of Science
La Plata. Universidad. Nacional. Facultad de Ciencias Quimicas
Laboratoire Arago, Université de Paris
Leicester Literary and Philosophical Society
Leipzig, Deutsches Institut fur Landerkunde
Leipzig, Museum fur Volkerkunde
Leipzig, Universitat
Leningrad, Universitet
Leyden, Rijksuniversitet
Linnean Society of London
Linnean Society of New South Wales, Sydney
Lisbon, Universidade, Faculdade de Ciencias
Liverpool, University, Marine Biological Station, Port Erin
Lloyd Library and Museum, Cincinnati
Louisiana Academy of Science
Lublin, Uniwersytet Marii Curie-Sklodowskiej
Magyar, Tudomany, Budapest
Magyar Tudamanyos Akademie, Budapest
Manchester Literary and Philosophical Society
Manchester Museum
Marine Biological Association of the United Kingdom
Marine Biological Laboratory, Wood's Hole
Michigan, University. Institute of Human Biology
  Museum of Anthropology
  Museum of Zoology
Michigan Academy of Science, Arts and Letters

Mining, Geological and Metallurgical Institute of India, Calcutta
Minnesota, University, Geological and Natural History Survey of Minnesota
Missouri, University, School of Mines and Metallurgy
Missouri Botanical Garden
Montana Academy of Science
Montreal, Université, Institut Botanique
Moskovskoe Matematicheskoe Abshchestvo, Moscow
Moskovskoe Obshchestvo Ispytatelei Prirody
Munster, Landesmuseum fur Naturkunde
Nantucket Maria Mitchell Association
Naples, Universita, Facolta di Agraria di Portici
Natal Museum, Pietermaritzburg
National Academy of Sciences, Washington
National Institute of Sciences of India
Natural History Society of Glasgow; and Glasgow and Andersonian Natural History and Microscopical Society
Natural History Society of Maryland
Natural History Society of Northumberland, Durham and Newcastle-Upon-Tyne
Naturforschende Gesellschaft, Bamberg
Naturforschende Gesellschaft, Basel
Naturforschende Gesellschaft, Freiburg i.B.
Naturforschende Gesellschaft, Zurich
Naturhistorische Gesellschaft, Nurnberg
Naturhistorische Verein der Rheinlande und Westfalens, Bonn
Naturwissenschaftlicher Verein, Bremen
Naturwissenschaftlicher Verein, Hamburg
Naturwissenschaftlicher Verein fur Schleswig Holstein, Kiel
Naturwissenschaftlicher Verein in fur Steiermark, Graz
K. Nederlandsche Akademie Van Wetenschappen
New York Academy of Sciences
New York Public Library
Norske Videnskabers Selskab, Trondhjem
Norske Videnskaps-Akademi, Oslo
North-East Coast Institution of Engineers and Shipbuilders, Newcastle-Upon-Tyne
Norway, Fiskeridirektoratet
Nova Scotia, Department of Mines
Notre Dame, Indiana, University
Oberhessische Gesellschaft fur Natur-und Heilkunde, Giessen
Ohara Institut fur Landwirtschaftliche Forschungen, Kurashiki, Japan
Ohio Historical Society
Okayama, Japan, University, Department of Mathematics
Oklahoma Academy of Science
Orszagos Mezogazdasagi Konyvtar, Budapest
Osaka, University, Faculty of Science
  Institute of Polytechnics
Pacific Marine Fisheries Commission
Panjab, University, Hoshiarpur
Paris, Muséum National d'Histoire Naturelle
Phillips Academy, Robert S. Peabody Foundation for Archaelogy
Pisa, Universita, Instituto di Agronomia Generale E Coltivazioni Erbacee

Pittsburg, Carnegie Institute, Museum
Plymouth Institution; and Devon and Cornwall Natural History Society
Polska Akademia Nauk, Instytut Geografii
    Instytut Zoologiozny
Polskie Towarzystwo Mikrobiologow, Warsaw
Portland Society of Natural History
Poznanskie Towarzystwo Przyjaciol Nauk, Posen
Prirodonaucen Musej, Skopje, Jugoslavia
Provincial Utretchtsch Genootschap van Kunsten en Wetenschappen, Utrecht
Queensland, University
Research Council of Israel
Reykjavik, Iceland, Institute of Technology, Communications, Department of Agriculture
Rio de Janeiro, Brazil, Museu Nacional
Rothamsted Experimental Station, Harpenden, England
Royal Canadian Institute, Toronto
Royal Dublin Society
Royal Geographical Society of London
Royal Irish Academy, Dublin
Royal Microscopical Society
Royal Physical Society
Royal Scottish Geographical Society
Royal Society of Arts, London
Royal Society of Canada
Royal Society of Edinburgh
Royal Society of London
Royal Society of New South Wales, Sydney
Royal Society of New Zealand, Wellington
Royal Society of South Australia, Adelaide
Royal Society of Tasmania, Hobart
Royal Society of Victoria, Melbourne
Sao Paulo, Brazil, Universidade, Faculdade de Filosofia, Ciencias E Letras
Sassari, Universita, Facolta di Agraria
Schweizerische Naturforschende Gesellschaft
Scottish Marine Biological Association
Senckenbergische Naturforschende Gesellschaft, Frankfurt
Sendai, Japan, University
Skopje, Jugoslavia, Museum Macedonicum Scientairum Naturalem
Smithsonian Institution, Bureau of American Ethnology
    U. S. National Museum
Sociedad de Biologia de Montevideo
Sociedad "Filipe Poey", Havana
Sociedade Broteriana, Coimbra, Portugal
Societa Di Naturalisti in Napoli
Societa Toscana Di Scienze Naturali Di Pisa
Societas Geographica Fenniae — Geografiska Sallskapet i Finland
Societas Scientiarum Fennica, Helsingfors
Société Belge de Géologie de Paléontologie et d'Hydrologie, Brussels
Société des Chimiques Belges
Société des Sciences de Nancy
Société des Sciences Naturelles de la Charente-Infériers, La Rochelle

Société des Sciences Naturelles de L'Ouest de la France, Nantes
Société des Sciences Naturelles de Tunisie, Tunis
Société d'Histoire Naturelle de Toulouse
Société Géologique de Normandie et des Amis du Muséum du Havre, Le Havre
Société Géologique du Nord, Lille
Société Linnéenne de Normandie, Caen
Société Lorraine des Sciences
Société Mathématique de France, Paris
Société Neuchâteloise des Sciences Naturelles, Neuchâtel
Société Royale Belge de Géographie, Brussels
Société Royale de Botanique de Belgique, Brussels
Société Royale des Sciences de Liége
Société Royale Zoologique de Belgique
Société Scientifique de Bruxulles
Société Scientifique de Bretagne, Rennes
Société Vaudoise des Sciences Naturelles, Lausanne
South African Museum, Cape Town
South Australia, Public Library, Museum and Art Galley, Adelaide
South Australian Museum, Adelaide
South Dakota Academy of Sciences
Southern California Academy of Sciences, Los Angeles
Split, Jugoslavia, Institut za Oceanografiju i Ribarstvo Splitu
State College of Washington
Staten Island Institute of Arts and Sciences
Station Biologique du St. Laurent
Stockholm, University, Docent of Physical Geography
Suomalainen Elain-ja Kasvitietsellinen Seura Vanamo, Helsingfors
Suomalainen Tiedeakatemia, Helsingfors
Sweden, Geologiska Undersokning
Taranto, Italy, Instituto Sperimentale Talassografico
Texas, University, Institute of Marine Sciences
Tokyo, Japan, University, Faculty of Agriculture
Tromso Museum
Tulane University, New Orleans
United States, Geological Survey
L'Université Laval
Upsala, Universitet, Mineralogisk-Geologiska Institut
Utah Academy of Sciences, Arts, and Letters
Verein fur Naturwissenschaftliche Heimatforschung, Hamburg
Verein fur Vaterlandische Naturkunde in Wuerttemberg, Stuttgart
Verein zur Verbreitung Naturwissenschaftlicher Kenntnisse, Vienna
Vermont, Geological Survey
Vetenskaps-Societeten i Uppsala
Victoria, Australia, National Museum
Victoria University College, Wellington, New Zealand
Vienna, Naturhistorisches Museum
Vsesoiuznyi Nauchno-Issledovatel 'skii Institut Morskogo Rybenogo Khoziaistva i Oceanographii, Moscow
Washington (State) University
West Virginia Academy of Science
Wisconsin Academy of Sciences, Arts and Letters
Wissenschaftliche Zeitschrift der Humboldt-Universitet zu Berlin
Zeiss Ikon in the Service of Science
Zoologisch-Botanische Gesellschaft, Vienna

PROCEEDINGS OF MEETINGS

Session of 1961 - 1962

(Meetings were held in the Medical Sciences Building of Dalhousie University, the Sir James Dunn Science Building of Dalhousie University, the Naval Research Establishment, Nova Scotia Technical College, the Queen Elizabeth Auditorium, and the Lord Nelson Hotel.)

100*th Annual Business Meeting*: October 16, 1961

The meeting was presided over by the President, Dr. W. J. Archibald. The Officers presented their reports.

The Treasurer, C. R. Masson, reported:

Receipts	$2,132.75
Expenditures	2,693.92
Bank Balance	1,347.19
Permanent Fund	397.50

The Librarian, Miss E. M. Campbell, reported:

There have been no significant changes in the Institute's library during the year 1960-1961. The binding program is being continued and the work of checking and arranging the material housed in the attic is going on continually.

There is a possibility that with the expansion of the Nova Scotia Technical College programs there may be some encroachment on the small space we have in the attic. In 1948, when the Provincial Science Library was divided, there was an arrangement made that the attic would be used solely by the Institute for its exchange material. Unfortunately that agreement has not always been kept and we are finding it difficult to keep the material in an accessible condition. We use the Institute's holdings for interlibrary loans and there has been a greatly increased use made of the exchange material in the last year.

We have added another range of steel shelves to the library this year, chiefly to make more room for Institute material.

The Proceedings, of which there have been two issues, have been mailed from the library to the exchange societies. There have been no new exchanges this year. Correspondence has been carried on with various societies about the exchanges, missing numbers, changes of address, etc. The Research

Foundation is continuing to finance subscriptions to societies which no longer send their material on an exchange basis.

The Quarterly Journal of the Geological Society of London will be sent to the Dalhousie Science Library where it will be kept in the Geological Library.

The Editor, H. S. Heaps, reported:

Two numbers of the Institute Proceedings were published during the year. These were Volume 24, Part 4 and Volume 25, Part I. They are dated 1957 - 1958 and 1958 - 1959. The next issue, Volume 25, Part 2, dated 1959 - 1960 will contain a paper entitled "A Forest Classification for the Maritime Provinces" by Dr. Loucks. Publication is awaiting the delivery of maps by the Department of Mines and Technical Surveys.

At present there are no manuscripts on hand for inclusion in Volume 25, Part 3 which will be dated 1960 - 1961.

Officers elected for the year 1961-1962 *were:*

President	Dr. W. J. Archibald
First Vice-President	Dr. J. A. McCarter
Second Vice-President	Dr. C. R. Masson
Treasurer	Dr. J. E. Stewart
Secretary	Dr. W. Yaphe
Editor	Professor H. S. Heaps
Librarian	Miss E. M. Campbell
Council	Dr. E. H. Anthony Professor E. L. Cameron, Dr. N. J. Campbell, Dr. J. H. Greenblatt, Dr. J. G. Retallack
Auditors	Dr. H. L. Bronson Dr. A. E. Cameron

New Members:

During the year the following new members were proposed and were elected by Council:

Ordinary: A. C. Neish, J. L. McLachlan, A. G. McInnes, D. L. Whalen, K. E. Hayes, P. Chadwick, H. B. S. Cooke, D. J. G. Nota, F. Aumento, M. J. Keen, Sylvia J. Fullerton, D. R. Idler, P. M. Townsley, H. Brockerhoff, G. C. Clough, I. M. MacQuarrie, H. Herata, F. Uyeno, W. S. J. Mass, A. L. Splitstone, G. A. Dauphinee, G. W. Holbrook, T. Randall, D. H. Loring, R. Platford, R. Chevrier, D. Peer, P. Tascherau,

W. F. Take, E. J. Dimelow, E. Levy, C. Boyd, M. R. Morgan, J. Findlay, C. Cheung, F. Weil.

Student Members: Carol Fleming, G. Digout, S. Lee, M. Telford, T. Wyatt, J. Waithaka, S. Pearre, A. Cotz, I. Harris, H. MacPherson.

Extraordinary Meeting, October 30, 1961.

Dr. Ramdohr, Professor Emeritus of Mineralogy at the University of Heidelberg, addressed the Institute on "Comparison of the Witwatersrand, Blind River District, and Dominion Reed Mineralization".

1*st Ordinary Meeting*, November 13, 1961.

Papers: 1. "The Influence of Surface Structure on the High Temperature Corrosion of Aluminum", by J. H. Greenblatt and J. T. N. Atkinson; 2. "The Synthesis of Pyrroles Related to Porphobilinogen", by G. P. Arsenault and S. F. MacDonald; 3. "The Nature of the Heat Stable Protein Isolated from Cod Muscle", by P. H. Odense and W. Shinners.

Extraordinary Meeting, November 16, 1961.

Dr. L. G. Elliott, Director of the Physics Division of Atomic Energy of Canada Limited, addressed the Institute on "Physics Research at Chalk River."

2*nd Ordinary Meeting*, December 11, 1961.

Papers: 1. "Large Signal Equivalent Circuits for Common-Emitter Transistor Amplifiers", by G. W. Holbrook; 2. "Protein Synthesis in Vitamin B6 Deficiency in the Rat", by W. W. Hawkins; 3. "Computation by Use of Completely Clipped Functions", by H. S. Heaps.

3*rd Ordinary Meeting*, January 8, 1962.

Papers: 1. "Position Annihilation in Zinc", by C. G. White; 2. "The Lipids of Cod Muscle and the Effect of Frozen Storage", by E. G. Bligh and Margaret A. Whitman; 3. "The Carbon-Oxygen Reaction in Liquid Iron", by W. D. Jamieson and C. R. Masson.

Extraordinary Meeting, January 22, 1962.

Professor Franklyn Hutchinson, Head of the Department of Biophysics of the Gibbs Laboratory at Yale University, addressed the Institute on "Progress in Radiation Biology".

4th Ordinary Meeting, February 12, 1962.

Papers: 1. "Systematics of the *Semiothisa Granitata* Complex (Insecta, Lepidoptera)", by D. C. Ferguson; 2. Immunoelectrophoresis of Tobacco Mosaic Virus from Radioactive Labelled Diseased Plant Extracts", by P. M. Townsley.

5th Ordinary Meeting, March 12, 1962.

Papers: 1. "Poliovirus Absorption to Cultured Mammalian Cells and Homologous Antibody", by K. R. Rozee, J. Casey, and S. H. Lee; 2. "Conversion of the Free Fatty Acids of Cod Oil to Methyl Esters in Situ", by R. G. Ackman; L. R. Gallay, P. M. Jangaard, and M. L. Hughes; 3. "Back-Scattering Strength of the Sea Surface", by R. P. Chapman.

Extraordinary Meeting, March 15, 1962.

Dr. Franz L. Alt, Assistant Chief of the Applied Mathematics Division on the National Bureau of Standards, addressed the Institute on "A Survey of Recent Progress in Machine Translation of Natural Languages".

6th Ordinary Meeting, April 9, 1962.

Papers: 1. "Formation of Cinnamic Acid Derivatives by Enzymatic Deamination of the Corresponding Phenylalanine Derivatives", by A. C. Neish; 2. "Inositol in Phospholipids", by H. Brockerhoff; 3. "A Seasonal Variation of Propagation on the Scotian Shelf", by N. O. Fothergill and J. D. Macpherson.

Centenary Meeting, Part I, March 27, 1962.

Dr. H. B. Newcombe addressed the Institute on "Man and his Genes."

Banquet and Dinner Meeting, April 6, 1962.

The Nova Scotian Institute of Science held its Centenary Dinner on Friday, April 6, 1962, as part of a program to mark the Institute's 100th year. Approximately 110 members' wives and guests attended. Among the distinguished guests were Major-General, The Honorable E. C. Plow, Lt. Governor of Nova Scotia; Mrs. Plow; The Honorable R. L. Stanfield Premier of Nova Scotia; Mrs. Stanfield; Mayor J. E. Lloyd of Halifax; Mrs. Lloyd; Captain W. Crook, Deputy Mayor of Dartmouth; Mrs. Crook.

In addressing the Institute the Lieutenant Governor congratulated the members on the long existence of their organization, especially since the first formal meeting of the Institute had been held in 1862. He expressed appreciation for the work of the Institute in the Province of Nova Scotia and he said that he was particularly pleased at the Institute's extensive publications on the flora and fauna of the Province in recent years.

The Premier congratulated the members of the Institute on the long existence of their organization and their high quality of scientific research. He expressed appreciation for the research effort of the Institute in Nova Scotia and acknowledged the contribution it had made to stimulating high quality scientific research in many disciplines of science in the Halifax area.

Mayor Lloyd in conveying greetings of the City of Halifax alluded to the fact that one of the founding members of the Institute in 1862 was then mayor of Halifax. He paid tribute to the Institute's contribution to the scientific research in the area and he hoped that the Institute would continue for a second fruitful hundred years.

Deputy Mayor Crook conveyed the greetings of the City of Dartmouth to the Institute and congratulated the members on the long existence of their organization.

Mr. D. C. Crowdis introduced the guest speaker Dr. C. B. Fergusson, the Provincial Archivist. Dr. Fergusson spoke on the scientific activity and organizations existing in Halifax before the formation of the Nova Scotian Institute of Science. He stressed the role of such prior organizations as the Mechanics Institute and the Provincial Museum in maintaining scientific interest before the founding of the present organization; he commented on their passing and recounted numerous interesting anecdotes about the activities and personalities of the period.

Dr. W. J. Archibald, President of the Institute, acted as Chairman of the Dinner. Before the dinner the members were received by Dr. Archibald, Mrs. Archibald, Dr. McPhee, President of the Institute's Annapolis Valley Chapter, Mrs. McPhee, and Dr. and Mrs. Fergusson. The toast to the Institute was proposed by Dr. E. G. Young of Halifax.

Among the guests present were the presidents of the local universities. They included Dr. A. E. Kerr, Dalhousie University; Dr. G. W. Holbrook, Nova Scotia Technical College; Rev. Canon H. L. Puxley, King's College; Dr. W. Kirkconnel, Acadia University; Rt. Rev. H. J. Somers, St. Francis Xavier University and Very Rev. C. J. Fischer, St. Mary's University. Dr. Lillian Wainright represented the President of Mount St. Vincent College.

Centennary Meeting, Part 2, April 14, 1962.

Sir Bernard Lovell, O.B.E., F.R.S. addressed the Institute on "The Exploration of Outer Space".

7th Ordinary Meeting, May 7, 1962.

Papers: 1. "The Kinetics of the Reactions of Active Nitrogen with Ethylene, Ethane, Propane, and Neopentane", by E. M. Levy and C. A. Winkler; 2. "A Tracer Study of the Phosphorus Cycle on Sea Water", by W. D. Watt; 3. "Life from Prehistoric Times, Discovery of Live Palaeozic Bacteria", by H. Dombrowski.

PROCEEDINGS OF MEETINGS

(Valley Chapter)

Session of 1961-1962

The Valley Chapter held eight meetings during the year.

Annual Business Meeting, November 6, 1961.

Officers elected for the year 1961-1962 *were*

President	Dr. A. W. MacPhee
Vice-President	Dr. J. S. Bleakney
Treasurer	Dr. A. D. Crowe
Secretary	Dr. R. G. Ross
Council	Dr. R. G. Moore

Dr. D. Dodds addressed the Chapter on "Aims and objectives of the recent Resources for Tomorrow Conference".

Extraordinary Meeting, November 14, 1961.

Dr. Elliott of Atomic Energy of Canada Ltd., Chalk River, addressed the Chapter on "Research in Physics at Chalk River".

1*st Ordinary Meeting*, December 4, 1961

Papers: 1. "Evidence of Three Pleistocene Till Sheets at Weymouth Mills", by R. H. MacNeil; 2. "Peoples and Problems of Nigeria", by F. C. Bent.

2*nd Ordinary Meeting*, February 5, 1962.

Papers: 1. "The Role of Organic Matter in Soil Formation", by J. R. Wright; 2. "Pollen Incompatibility and Fruit set in Lowbush Blueberries", by L. E. Aalders and I. V. Hall; 3. "Production of Perithecia of *Venturia Inaequalis* on Sterile Apple Leaf Discs", by R. G. Ross.

3*rd Ordinary Meeting*, March 5, 1962.

Papers: 1. "Microclimatology", by E. I. Mukammal; 2. "Terrestrial Molluscs in the Environs of Wolfville", by R. G. Moore.

Public Lecture, March 26, 1962.

Dr. H. B. Newcombe of Atomic Energy of Canada Ltd., Chalk River, gave a public lecture at University Hall, Acadia University, entitled "Radiation, Man and His Genes".

4*th Ordinary Meeting*, April 2, 1962.

Papers: 1. "Lung Resection for Tuberculosis in Children", by J. J. Quinlan, V. D. Schaffner, and J. E. Hiltz; 2. "The History of Chest Surgery", by J. J. Quinlan.

5*th Ordinary Meeting*, April 30, 1962.

Papers: 1. "Ageing Methods in Mammals with Special Reference to the Short-Tailed Weasel", by R. S. Cain; 2. "The Terpenes as Starting Materials in Steriod Synthesis", by Raymond Ng; 3. "Stratigraphy and Paleontology of a Section of the Windsor Group near Brooklyn, Nova Scotia", by D. MacDonald.

ABSTRACTS

(Papers read before the Institute but not published in the Proceedings).

THE INFLUENCE OF SURFACE STRUCTURE ON THE HIGH TEMPERATURE CORROSION OF ALUMINUM. By J. H. GREENBLATT and J. T. N. ATKINSON, Naval Research Establishment. (Read November 13, 1961). The surface films formed on specimens of commercially pure aluminum and two special alloys containing iron and nickel have been examined after short periods of exposure to high temperature pure water over the temperature range of 150° - 350°C. Certain topographical features of the external crystalline interface of the surface oxide film have been observed, and their presence and position correlated with the position of second phase particles in the original metal surface. Similar topographical features have also been noted on the internal amorphous metal-oxide interface of the oxide film. The films have also been examined in cross section using specially developed techniques and the composite structure of the oxide film and the effect of intermetallic second phase particles have been further detailed. The rates of growth of the component parts of the surface film are discussed in terms of observed long term corrosion behaviour of these alloys.

THE SYNTHESIS OF PYRROLES RELATED TO PORPHOBILINOGEN. By G. P. ARSENAULT and S. F. MACDONALD,
(Read November 13, 1961). A study of the decarboxylation of pyrroles related to 5-carboxy-porphobilinogen has lead to an improved synthesis of porphobilinogen, to *iso*-porphobilinogen, and to other pyrroles required for the preparation of possible intermediates in the biosynthesis of porphyrins.

THE NATURE OF THE HEAT STABLE PROTEIN ISOLATED FROM COD MUSCLE. By P. H. ODENSE and W. SHINNERS, Fisheries Experimental Station. (Read November 13, 1961). Bourdillon and Baker in 1956 reported the isolation of a heat stable protein from beef. Similar treatment of cod muscle has yielded a crystalline protein fraction with the same properties; further studies have shown that this protein is not a new asymmetric structural protein from muscle but is a form of tropomyosin. This has been confirmed by crystallization of the protein in the characteristic form of tropomyosin crystals as well as by amino acid analysis and comparison of electrophoresis and ultracentrifuge patterns with those of tropomyosin.

LARGE-SCALE EQUIVALENT CIRCUITS FOR COMMON-EMITTER TRANSISTOR AMPLIFIERS. By G. W. HOLBROOK, Nova Scotia Technical College. (Read December 11, 1961). Equivalent circuits which describe the large-signal operation of the common-emitter transistor amplifier are developed. The circuits relate to the input resistance and transfer resistance of the amplifier, as a whole, and can be used to predict the degree of non-linear distortion arising in the amplifier. Use of these equivalent circuits is restricted to low frequency operation as no account is taken of the inherent capacitance of the transistor.

PROTEIN SYNTHESIS IN VITAMIN B6 DEFICIENCY IN THE RAT. By W. W. HAWKINS, Atlantic Regional Laboratory. (Read December 11, 1961). Young albino rats of both sexes were divided into three groups of 63-67 animals each, with a mean body weight of 87g. They were fed a diet containing 16% protein. Those in one group were deprived of vitamin B_6. Those in another were given the same amount of food, and those in the third group were given less food to keep their body weights within the same range as those deprived of vitamin B_6. After 65 days the vitamin-deprived animals and the weight controls had gained 64% and the food controls 112% of the initial body weight.

At this stage there were no significant quantitative differences among the three groups as revealed by the ratio of liver to body weight, the concentration of protein in the liver, and of protein and non-protein nitrogen (NPN) in the blood plasma. The concentration of NPN in the liver was significantly higher, by an average of about 25%, in the inanition controls than in the other two groups, which differed in this respect to an insignificant extent of about 5%.

Dietary protein depletion was then imposed for 25 days, followed by repletion with a diet containing 40% protein for 3 days.

With protein depletion the ratio of liver to body weight increased in all the animals, and remained at essentially the same level after repletion, with no important differences among the groups. The concentrations of protein in the liver and plasma and of NPN in the liver decreased and increased respectively in response to the changes in amounts of dietary protein, and among the three groups the quantitative changes were not significantly different except in the case of the liver NPN. The difference in it between the animals in the weight-control group and those in the other two groups disappeared during protein depletion and repletion. The NPN in the blood plasma was not significantly affected in any group by protein depletion, but it rose with protein repletion. At all stages it was somewhat higher in the vitamin B_6-deficient animals.

The results of this experiment support the concept that when in vitamin B_6 deficiency there is increased catabolism of amino acids it is a reflection of a defect in their non-oxidative metabolism and not in anabolic processes.

COMPUTATION BY USE OF COMPLETELY CLIPPED FUNCTIONS. By H. S. HEAPS, Nova Scotia Technical College. (Read December 11, 1961). A function is said to be completely clipped if its value is replaced by +1 whenever it is positive and by −1 whenever it is negative. The proceeding of data is often greatly simplified if the data is first clipped. For example, data may usually be sampled and recorded more quickly if only the sign of each sample is recorded. The present paper analyses the extent to which complete clipping of functions may affect the computation of Fourier transforms and correlation functions.

POSITRON ANNIHILATION IN ZINC. By C. G. WHITE, Dalhousie University. (Read January 8, 1962). The momentum distribution of valence electrons in zinc has been investigated by irradiating zinc with positrons. Mutual annihilation of positrons and valence electrons takes place, causing a conversion of mass to energy in the form of emitted gamma rays. The momentum distribution of annihilating electrons is measured by analyzing the resulting gamma radiation. Results obtained for zinc at a number of temperatures in both solid and liquid phases indicate a decrease in average momentum of electrons as the temperature is increased. The experimental technique and results will be described.

THE LIPIDS OF COD MUSCLE AND THE EFFECT OF FROZEN STORAGE. By E. G. BLIGH and MARGARET A. WHITMAN, Fisheries Experimental Station. (Read January 8, 1962). Silicic acid chromatography has been used in studies concerning the lipids of cod muscle. A system employing gradient elution has been set up which separates cod lipid into nine distinct components and thus provides an excellent means of following composition changes resulting from frozen storage. Results have shown that in stored frozen cod there is preferential hydrolysis of certain phospholipids.

SYSTEMATICS OF THE SEMIOTHISA GRANITATA COMPLEX (Insecta, LEPIDOPTERA). By D. C. Fergusson, Nova Scotia Museum of Science. (Read February 12, 1962). This investigation concerns the taxonomic revision of a confusing group of conifer-feeding Geometrid moths that occur widely in North America. The previous concept of the included species and their nomenclature was thought to have many inadequacies. This has been confirmed by a combination of morphological and ecological information accumulated over a period of years. The study resulted in a reallocation of many specific names, the working out of food plant relationships (which were found to be quite specialized), discovery of four additional species not formerly recognized, and removal of two species from association with this immediate group, one of these to another genus. It is now believed that the GRANITATA complex consists of ten very similar species that became divergent as a corollary of adaptation to specific food-plants, and that this represents an especially clear example of evolutionary radiation in an early stage.

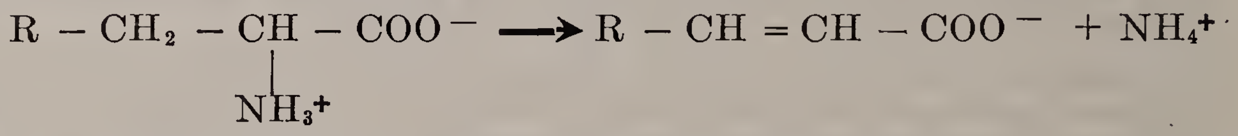
IMMUNOELECTROPHORESIS OF TOBACCO MOSAIC VIRUS FROM RADIOACTIVE LABELLED DISEASED PLANT EXTRACTS. By P. M. TOWNSLEY, Fisheries Experimental Station. (Read February 12, 1962). Immunoelectrophoresis was used as a method to fractionate crude diseased extracts. The fractions or zones peculiar to diseased extracts were examined using phosphorus P32, leucine C14 and phenylalanine C14. Direct measurements of infectivity, serological activity, electron microscopy and rate of incorporation of isotopes were obtained. From the data an hypothesis for TMU virus synthesis withint the cell will be presented.

POLIOVIRUS ADSORPTION TO CULTURED MAMMALIAN CELLS AND HOMOLOGOUS ANTIBODY. By K. R. ROZEE, J. CASEY and S. H. LEE, Dalhousie University. (Read March 12, 1962). The conditions of temperature and ionic concentration have been investigated for their ability to influence the primary attachment of poliovirus type 1 to cultured Rhesus monkey cells. Attempts were made to assess the effect of these variables on the rate of adsorption of homologous and heterlogous antibody by strains of poliovirus type 1. A method was developed having sufficient reliability to allow cross comparions by neutralization kinetics of strains of poliovirus type 1 having paralutogenic artifically attenuated and naturally attenuated characteristics. The method was applied to determine reasons for pecularities occuring during the 1959-1960 Maritime Provinces poliovirus epidemic.

CONVERSION OF THE FREE FATTY ACIDS OF COD OIL TO METHYL ESTERS IN SITU. By R. G. ACKMAN, L. R. GALLAY, P. M. JANGAARD, and M. L. HUGHES, Fisheries Technological Station. (Read March 12, 1962). Cod oil, a product of our fisheries on the Atlantic Coast, has a limited market owing to the fact that, as an oil, it contains a very high proportion of free fatty acids. Means have been sought to reduce this free fatty acid value and an esterification procedure based on 2,2-dimethosypropane has been developed which can reduce the free fatty acid content of the oil to desirable levels.

Back-Scattering Strength of the Sea Surface. By R. P. Chapman, Naval Research Establishment. (Read March 12, 1962). Surface reverberation has been studied in the frequency range from 400 to 6,400 cycles per second using explosives as the source of sound. Scattering strengths in octave bands have been computed over a range of frequencies, wind velocities, and grazing angles. The characteristics of the scattering mechanisms involved are discussed.

Formation of Cinnamic Acid Derivatives by Enzymatic Deamination of the Corresponding Phenylalanine Derivatives. By A. C. Neish, Atlantic Regional Laboratory. (Read April 9, 1962). Studies on the metabolism of C14—labelled compounds by plants have indicated that p-coumaric acid may be formed by at least two pathways (see A. C. Neish, Ann. Rev. Plant Physiol., vol. 11, p. 55, 1960). One of these pathways involves p-hydroxylation of a phenyl compound, presumably cinnamic acid. The enzyme involved is unknown. The other pathway is responsible for the conversion of tyrosine to p-coumaric acid. It is well developed in grasses but not in legumes. A soluble enzyme was extracted from certain grasses (e.g., rice, barley) which catalysed the ammonia-lyase reaction:



$$\mathrm{R - CH_2 - \underset{\displaystyle NH_3^+}{\underset{|}{CH}} - COO^- \longrightarrow R - CH = CH - COO^- + NH_4^+}$$

L-Tyrosine (p-hydroxy phenylalanine) p-Coumaric acid

This enzyme has been named tyrase. Its properties are discussed, as well as its possible role in lignification. The extracts containing tyrase also catalysed ammonia-lyase reactions with phenylalanine (see J. Koukol and E. Conn, J. Biol. Chem., vol. 236, p. 2692 (1961), and m-hydroxyphenylalanine (Neish, Phytochemistry 1: 1, 1961). There is some evidence that separate enzymes are involved.

Inositol in Phospholipids. By H. Brockerhoff, Fisheries Experimental Station. (Read April 9, 1962). Myo-inositol (hexahydroxy cyclohexane) is an essential growth factor for many microorganisms and animals. As such it is incorporated into the lipids of cells, specifically into the phosphatide, or phospholipid, fraction. The simplest of the resulting compounds, phosphatidyl inositol, or monophospho-inositide, is very similar in structure to the best known phosphatide, lecithin, or phosphatidyl choline. A phosphatidyl group, that is glycerol esterified with phosphoric acid and two fatty acids is linked, through the phosphate, to inositol. Monophosphoinositide seems to be universally distributed both in the plant and the animal kingdom. Of its function, nothing is known.

More complicated compounds occur in particular animal tissues only, mainly in nervous tissue and possibly in kidney and heart. These inositides differ from monophosphoinositide in that they contain one or two additional phosphate groups; accordingly, they have been named di- or triphosphoinositide. Structural analysis has shown that the new phosphate groups are monoesterified and are bound to the inositol. Studies on the incorporation of radioactive phosphate, glycerol, and inositol, in rabbit brain slices have given the following result: Monophosphoinositide is rapidly phosphorylated to di- and thus to triphosphoinositide. The reactopms may be either reversible, or they may be parts of a metabolic cycle. One possible role of the phosphoinositide complex in nerves is that it serves as a carrier for the transport of cations.

A Seasonal Variation of Propagation on the Scotian Shelf. By N. O. Fothergill and J. D. Macpherson, Naval Research Establishment. (Read April 9, 1962). From 1957 to 1960 a series of propagation experiments were carried out on the Scotian Shelf. In the summer and fall of each year a large seasonal systematic variation of attenuation was observed. This variation was apparently caused by a change in the vertical temperature structure. A ray theory is presented which successfully predicts this variation and also gives information about the bottom reflection coefficient.

The Kinetics of the Reactions of Active Nitrogen with Nitrogen with Ethylene, Ethane, Propane, and Neopentane. By E. M. Levy, Atlantic Regional Laboratory, and C. A. Winkler, McGill University. (Read May 7, 1962). Kinetic constants were determined for the reactions of active nitrogen with ethylene, ethane, propane, and neopentane in the temperature range 295° to 673°K.

At 333°K., the average kinetic constants were: Ethylene: $k = 1.9 \times 10^{-14}$ cc/molecule sec, $E = 0.43$ kcal/mole, $P = 9.5 \times 10^{-5}$; Ethane: $k = 9.23 \times 10^{-16}$ cc/molecule sec, $E = 3.78$ kcal/mole, $P = 5.4 \times 10^{-4}$; Propane: $k = 1.0 \times 10^{-15}$ cc/molecule sec, $E = 4.24$ kcal/mole, $P = 8.9 \times 10^{-4}$; Neopentane: $k = 6.6 \times 10^{-16}$ cc/molecule sec, $E = 1.93$ kcal/mole, $P = 2.6 \times 10^{-5}$.

A mechanism consisting of an initial and rate controlling nitrogen atom attack on the hydrocarbon, followed by rapid reactions of nitrogen atoms with free radicals, is proposed to account for the kinetics of all four reactions.

A Tracer Study of the Phosphorus Cycle in Sea Water. By W. D. Watt, Institute of Oceanography. (Read May 7, 1962). When an aquatic biological system approaches a steady state the distribution of dissolved inorganic phosphorus (DIP), particulate phosphorus (PP) and dissolved organic phosphorus (DOP) may be dealt with as though it were the result of a chemical equilibrium. The rates of exchange have been calculated for coastal sea water collected in late summer near Halifax, Nova Scotia.

Sea water was allowed to equilibrate with DIP32; passed through a membrane filter of 0.5μ pore diameter and DIP32 removed by taking advantage of the phosphate exchange properties of Fucus vesiculosis. As much as 20% of the P32 in the resulting solutions was in an inorganic form adsorbed onto particles less that 0.5μ but greater than 10 mμ in diameter. P32 labelled dissolved organic phosphorus from sea water was resolved by paper chromatography into six components: three are phosphorylated carbohydrates, two are of nucleotide nature, and one is tentatively identified as deoxyribo-nucleic acid.

OBITUARY

Miss Margaret Brown, whose death at the age of 96 occurred on November 1961, was the oldest living member of the Nova Scotian Institute of Science.

Miss Brown was a bryologist and was the chief authority on the mosses and liverworts of Nova Scotia. Her paper "The Liverworts and Mosses of Nova Scotia" was published in the *Proceedings* volume 19, part 2, 1936.

She received a degree from the University of Kings College and undertook further studies in Stuttgart, Germany. As a bryologist she was widely known and on several occasions she was asked to conduct field parties in Nova Scotia, most important of these was the one headed by Dr. Nathaniel Britton of the New York Botanical Gardens. This was in Cape Breton Island. A new species was named for Miss Brown in Dr. Britton's book "Illustrated Flora of Northern United States, Canada and British Possessions."

During the 1st World War, Miss Brown and Professor Thompson of the University of Toronto organized and directed in Arichat a project for the collection and preparation of *sphagnum* to be used in wound dressings for the soldiers and for matresses of ambulances.

Miss Brown's grandfather, a geologist, R. H. Brown, was the author of the important work, "The Coal Fields and Coal Trade of the Island of Cape Breton" published in London in 1871. This book is now out of print and considered a very valuable addition to any library.

In 1950 Acadia University conferred on Miss Brown an honorary Masters degree.

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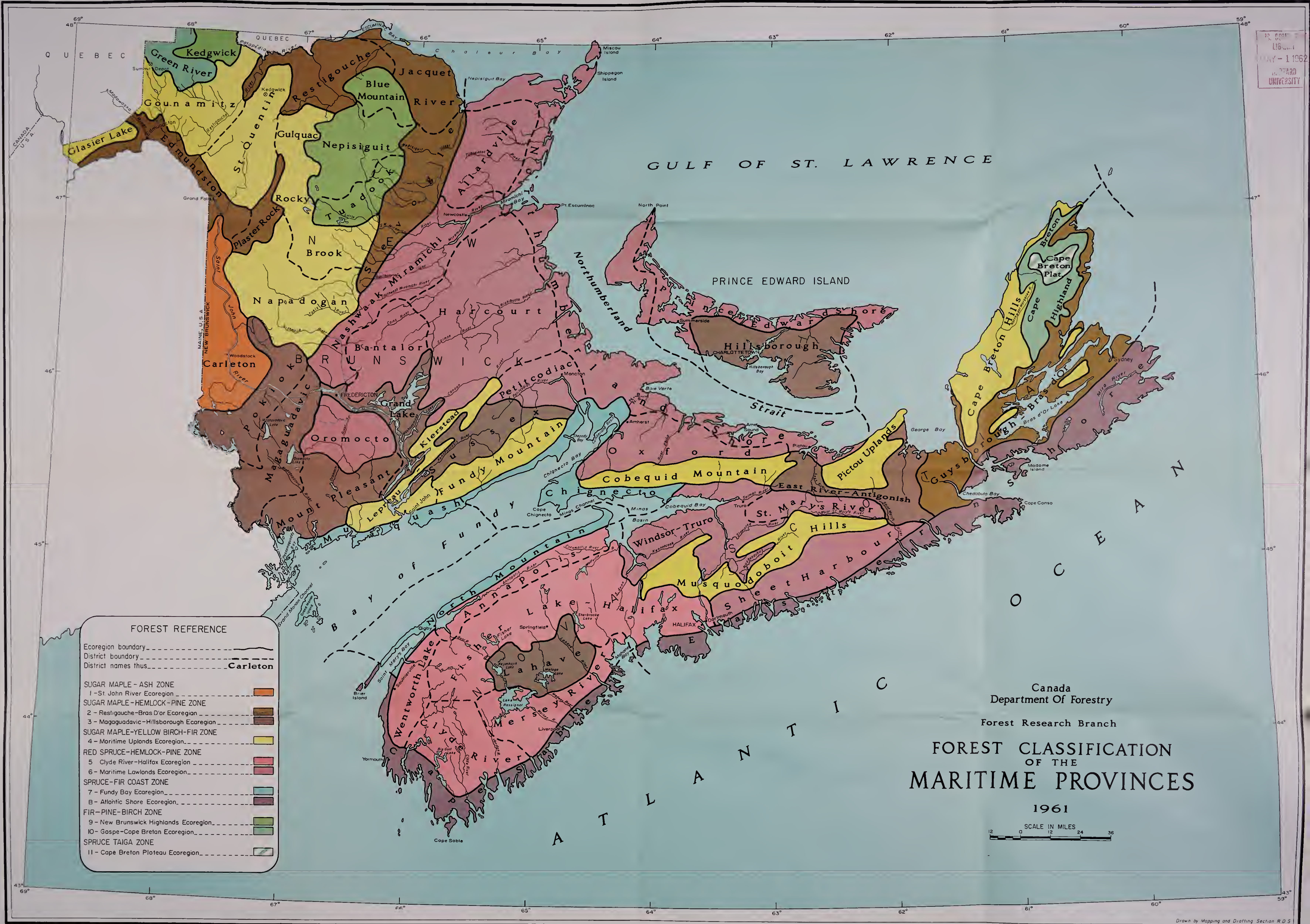

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